



**TECHNICAL EDUCATION IN INDIA SINCE 1970**  
**A SELECT ANNOTATED BIBLIOGRAPHY**

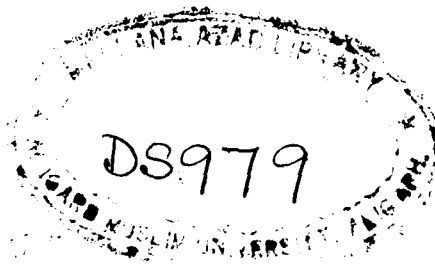
**SUBMITTED IN PARTIAL FULFILMENT FOR THE AWARD  
OF THE DEGREE OF  
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**BY  
SHUJAT HUSAIN**

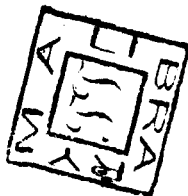
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**DEPARTMENT OF LIBRARY SCIENCE  
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DEDICATED  
TO  
THE LASTING MEMORY OF MY FATHER  
LATE SHARAFAT HUSAIN  
WHO DID EVERYTHING POSSIBLE FOR ME  
BUT DID NOT SEE IT  
IN ITS FINAL SHAPE.

## A C K N O W L E D G E M E N T S

Appreciation is due to Prof. M.H. Razvi, Head of the Department of Library Science, who actually supervised the compilation of this bibliography. I offer my thanks to Mr. Shabahat Husain, ~~Lect.~~ Lect. :, Department of Library Science, whose valuable guidance and suggestions were always available to me. I am grateful to Mr. M.A. Jafri and Mrs. Rafia Parveen who did a lot during my study period. I am also grateful to Shri P.K.M. Menon who assisted me in typing of this thesis.

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SHUJAT HUSAIN.

## P R E F A C E

Since knowledge is increasing by leaps and bounds and there is almost a flood of documents, it is a challenge to the librarians and information scientists to develop such tools and techniques which can cope with this torrent of information. Technical Education is one of the burning topics of today. It is for this reason, I have selected this topic for my dissertation which has to be submitted in the partial fulfilment of the requirements for the award of the degree of Master of Library Science.

The present work consists of two moieties. The first is the introduction part in which a detailed account of Technical Education has been covered.

Part two consists of a list of periodicals, list of abbreviations and list of UDC numbers used, the main bibliography and author and keyword index.

### Source of Compilation:

The bibliography includes 250 entries which are not comprehensive but are fairly representative of the subject. While starting with this venture, a general survey of the literature available in important libraries viz. CSIR Library, IIT, Delhi Library, Central Secretariate

## II

Library, Planning Commission Library, NCERT Library and UGC Library was made. Help was also sought from some indexing and abstracting service, viz. Indian Education Abstracts, Indian Education Materials and Index India. Out of the fairly large number of periodicals covering the field, only important ones were selected for this purpose.

### Arrangements:

Efforts have been made to arrange the entries under Universal Decimal Classification numbers and its subject headings. For this purpose a comprehensive list of UDC number and its subject headings was compiled which is given as Chapter 2.2.

The entries are serially numbered and the following items of information are contained in the various entries.

- (a) Serial number
- (b) Name of author/authors
- (c) A full stop (.)
- (d) Title of contribution including subtitle and alternative title, if any
- (e) The full stop (.)
- (f) Title of periodical in full form.
- (g) A full stop (.)
- (h) Volume number
- (i) A comma (,)

### III

- (j) Issue number, denoted by 'N'
- (k) A semi colon (;)
- (l) Year
- (m) A comma (,)
- (n) Month
- (o) A semi colon (;)
- (p) Inclusive pages of the article.

#### Specimen entry :

250 WAKHLU (ON).

Problems of Engineering College in India with regard to teaching and research.

Indian Journal of Technical Education. 7, N1;  
1981, Apr; 32-5.

#### Abstracts

The entries in the bibliography contain abstracts giving the essential information about the articles documented. An important feature of this bibliography is that I have given informative abstracts rather than indicative and I feel a needy researcher need not to consult the original articles in the periodicals.

#### Alphabetical Indexes

Bibliography contains an exhaustive author and keyword index arranged alphabetically. The number against each entry in the index is the serial number of the entry in the list are given.



#### IV

##### Keyword Index

The system of keyword indexing <sup>is the same,</sup> as used in Indian Science Abstracts. It may be called keyword with context (KWWC) indexing. The keyword along with the context is selected by the abstractor. Index entries are chosen from the word used by the author.

**Index Entries:** Generally, a keyword entry consists of a) main heading, b) context, and c) identification number. The main heading, consists of i) keyword, and ii) qualifier(s). The sub-heading which is placed below the main heading with an indention, is termed as context.

a) **Main Heading** - The main heading consists of a noun (or a phrase), or a noun qualified by one or two adjectives which are termed as qualifier(s). Normally an inverted form is used so that the adjectives follow the noun. A comma is interposed between the noun and the adjective, e.g.

TECHNICAL EDUCATION is indexed as  
EDUCATION, TECHNICAL.

b) **Context** - It is a brief description of the subject dealt with in the document and is an elaboration of the keyword, e.g.

TECHNICAL EDUCATION PROBLEM is indexed as  
PROBLEM  
TECHNICAL EDUCATION.

\* \* \* \* \*

**PART - 1**

**INTRODUCTION**

## HISTORICAL BACKGROUND

### Pre-Independent Period

It is fairly well-known that Indian education under British rule had a predominantly literary bias. In schools and colleges the teaching of sciences and of technical and vocational subjects was by and large neglected; the emphasis was on the study of literature and logic, politics and philosophy. This is not surprising since in Britain also no serious attention was given to technical education till the 1860s.

The idea of providing technical education to the people of India by the Government was first mentioned in Sir Charles Wood's Educational Despatch of 1854. It stated:

Our attention should now be directed to a consideration if possible, still more important, and one which has hitherto, we are bound to admit, been too much neglected, namely, how useful and practical knowledge suited to every station in life may be best conveyed to the great mass of the people who are utterly incapable of obtaining any education worthy of the name by their own unaided effort; and we desire to see the active measures of Government more especially directed for the future to this object, for the attainment of which we are ready to sanction a considerable increase of expenditure.

When soon after this, colleges and universities were established, while law, medicine, and civil engineering received attention, technical and industrial education escaped notice. The Indian Education Commission in 1882 advised the introduction of a "modern" side into High Schools and suggested the starting of industrial schools.

The Government of India Resolution of 23rd October, 1884  
said that:

The bifurcation of studies suggested by the Committee is of special importance at the present time. Every variety of study should be encouraged, which may serve to direct the attention of native youth to industrial and commercial pursuits.

The subject was taken up by Lord Dufferin at whose instance in July, 1886, A.P. MacDonnell, then Home Secretary, prepared an elaborate memorandum setting forth the history of technical education in India, the actual conditions and the lines of future development. MacDonnell examined the condition of technical education in the various provinces and the steps taken by each local government to give effect to the orders of the Government of India regarding the necessity of improving practical and industrial training. He found that nowhere, except in Madras, had any practical steps been taken to give effect to these orders. As regards engineering, MacDonnell pointed out that the nature of teaching at Calcutta, Madras and Roorkee was too theoretical and these colleges were completely isolated. Suggestions were put forward regarding teaching of science and drawing at the primary school stage and starting the "modern" side of high schools and divisional or district technical schools.

In the meantime the Government of India issued a Resolution of Education in June, 1888, in which it stated that since industries had not developed in India, it would be premature

to establish technical schools on a large scale since this would only aggravate the problem of the educated unemployed. It suggested that local governments should undertake industrial surveys and then decide which kind of special technical schools would be immediately useful.

Sir Auckland Colvin, Lieutenant-Governor of North Western Provinces and Oudh, proposed the re-organisation of the Roorkee Engineering College, various other local governments also made suggestions for improvement.

In 1900, Lord Curzon, the Viceroy, appointed Sir Edward Buck to make certain enquiries about practical and technical education. Buck produced a lengthy report but his recommendation that technical and industrial schools should be placed under a separate technological department was never carried out.

Buck's Report was considered at the Simla Conference of 1901. After the Conference, Curzon constituted a committee to go into the question of industrial education. The committee under the chairmanship of Col. Clibborn produced another Report but once again its recommendations were not accepted by the Government. "The Report", wrote Curzon, "distracts and infuriates everyone who reads it ...ignores nearly every instruction given to its authors...violates almost every fundamental principle laid down not only by the Government of India alone, but by the great body of experts everywhere, which has already wasted a year of our time and will probably waste

much—very much more...I have never seen or met a single member of this committee except Col. Clibborn, and after an hour of him, I wanted no more". The needs of the time were noticed in the Resolution of 1904 on Indian Education Policy and the matter was referred to local government. Between 1907 and 1911 almost every local governments appointed a committee and produced various schemes. Series of industrial surveys were conducted and industrial conferences convened.

The United Provinces, Government held a Conference at Nainital which recommended the constitution of an Industrial Department under a Director of Industries who would control technical education and deal with industrial questions generally. It also recommended a technological institute at Kanpur, a school of design, two industrial schools, an experimental weaving station, a carpentry school, and the introduction of practical work in general education.

The Ootacamund Industrial Conference of 1908 recommended that technical education should be under the control of the Director of Industries, and that the College of Engineering in Madras should be expanded. The Madras Government started a Department of Industries, but Lord Morley, the Secretary of State, disallowed the pioneering of industries by the Government on the ground that state funds might be "expended upon familiarising people with such improvements in the methods of production as modern

science and the practice of European countries suggest; further than this the state should not go, and it must be left to private enterprise to demonstrate that these improvements can be adopted with commercial advantage". The limitations of policy laid down in this despatch prevented for a time any further development of the principle of direct industrial effort by Government. Lord Crewe who succeeded Morley at India Office, allowed Madras greater latitude by expressing himself in favour of "the purchase and maintenance of experimental plants by the government". As a result, Madras was allowed to reconstitute a Department of Industries in 1914 and the superintendence of industrial education was placed under it.

The question, whether technical and industrial education should be under the Department of Public Instruction or transferred to the Department of Industries, was considerably debated during these years. Different arrangements existed in different provinces. Madras created a Department of Industries and the Director undertook inspection of industrial schools. This system was vetoed by the Secretary of State, but revived in 1914.

Engineering education was ~~thus~~ closely linked to the P.W.D. In 1917 a Committee was appointed under the chairmanship of F.G. Sly to consider the re-organisation of the P.W.D. Its major recommendations were — (1) retention of the four engineering colleges and their continuance under the control of local governments, as against their concentration or their subjection to an Imperial Advisory

Board; (2) the abolition of upper subordinates and thus have only two grades in the P.W.D.—engineers and subordinates; (3) the recognition of the Intermediate degree of a university as the minimum qualification for entrance to engineering courses and the Matriculation or equivalent school leaving examination for entrance to subordinates' course. The Committee was of the view that the maximum age limit of entry should be lowered. It laid great emphasis on practical training for engineers, and suggested a five-year course, two years of which should be on the works; for subordinates a four-year course of which three years should be spent in college and one year in practical training was recommended.

Even as late as 1919 senior government officials were arguing that one engineering college for the whole of India would suffice and that an output of about a hundred civil engineers was enough.

One of the main reasons for the slow growth of engineering education was the lack of employment opportunities for highly trained Indians. Their main employers were government and private industry. The former reserved the Imperial Service of Engineers and other superior services for Europeans and to the Provincial Services 9 to 10 appointments only were made each year from the five engineering colleges.



In Great Britain, railways were considered the best training ground for mechanical engineers. In India the government followed a policy of discouraging the growth of railway and ancillary industries together with discriminating against training Indians as apprentices in railway workshops. Railways ought to have been a big employer of technically trained men but here upper and middle class appointments were held mostly by Europeans and Anglo-Indians. In 1913, for instance, they held 90 per cent of the posts carrying a salary of Rs. 500 and above, although they formed only 0.08 per cent of the population. In 1921 there were 1,315 European and Anglo-Indian officers against 262 Indians.

The Atkinson-Dawson Committee appointed by the Government in 1912 to enquire into bringing technical institutes into closer touch with employers of labour in India came to the conclusion that there was practically no opening for those who possessed higher theoretical training but ample scope for the practically trained. Its Report said that it was almost the universal opinion of the employers they had interviewed that "a man however carefully trained in a technical institute was utterly useless...till he had practical experience...". There was almost no opening for higher grade mechanical and electrical engineers in India. It is clear from these Reports that there was a bias among the major European employers against hiring Indians. Given this fact, Government did not feel impelled to encourage higher technical education.

In the last quarter of the nineteenth century technical education became a subject of interest in England as it was realised that Britain was facing serious industrial competition from Germany and the United States of America both of whom were much more advanced in technical education. A Select Committee on scientific instruction concluded that the pressure of foreign competition could be partly attributed to a failure of scientific and technical instruction in Britain. A Royal Commission on Scientific Instruction and Advancement of Science was appointed in 1870-75 with the Duke of Devonshire as Chairman. In 1881 a further Royal Commission was appointed with Sir Bernhard Samuelson as Chairman to enquire into technical education. The main argument for technical education was its contribution to industrial prosperity and efficiency.

In the same years Indian nationalists also started pressing for more government expenditure and facilities for technical education. They came to believe that lack of technical education was a major cause of India's economic retardation and that the British were deliberately denying technical training to Indians. As its third session in Madras in 1887, the Indian National Congress passed a resolution "that having regard to the poverty of the people, it is desirable that the Government be moved to elaborate a system of technical education....." This resolution was repeated in different words year after year. There were references to "the imperative need for technical

education" in the Congress Presidential address by W.C. Bonnerji in 1892, Anandamohan Bose in 1898, Chanda-varkar in 1900, Madan Mohan Malaviya in 1909 and in subsequent years also. Indian newspapers were also continually criticising the government for not making enough provision for technical education. The native newspapers, reports for almost any year during this period and for any province contain numerous criticisms of the official policy on technical education, the chief target being inadequate expenditure. When the Curzon fund for commemorating Queen Victoria had amounted to Rs. 1.5 crores, public opinion was strong that the money should be used for advanced technical education.

An industrial conference sponsored jointly by Indian industrialists and the Indian National Congress was held at Benaras in December 1905 and thereafter met every year as an adjunct of the Congress. The Benaras Conference suggested that the Government should establish at least one Polytechnic Institute for the whole of India and one technological college for each province. Rao Bahadur R.N. Mudholkar introduced a resolution in the Imperial Legislative Council in 1910 for the establishment of a Polytechnical Institute. He was supported among others by Muhammad Ali Jinnah. This was the first time that the question of technological instruction came up for consideration in the Imperial Legislative Council. But such proposals

coming from Indians were always dismissed by officials as vague or impractical or showing a lack of appreciation of the difficulties of the problem. Curzon rejected them as "native clamouring for things about which they know nothing". Minto's officials assured him that such "harmless platitudes" deserved no serious consideration.

However, Indian business and political leadership took the initiative in advancing the study of science and technology. The leaders of the Swadeshi movement in Bengal started a college of engineering and technology at Jadavpur in 1907. While other national schools and colleges started at the same time collapsed ignominiously the technical college survived and flourished which was itself a proof of the demand for technical education.

Lord Hardinge's government realized that there was a genuine popular demand for technical education. Moreover, it was also concerned with the problems of educated unemployment. The Viceroy suggested to Lord Crewe that a grant of a crore of rupees for technical education could be the boon, the King may announce, as a gift from England at the Coronation Durbar. He thought that such an announcement would appeal tremendously, "to the imagination and impressionability of Indian people....."and hopefully believed that as a result "all doubtful moderates would rally to the side of loyalty" and they would hear no more of sedition for a long time to come. Hardinge was

obviously impressed by the views of Sir George Clarke, Sir John Hewett, and others that expenditure on technical education was worthwhile since it would divert young men from universities and high schools into commercial and industrial lines, and thus reduce political discontentment. Absurd, though it seems, he believed that Indian extremists were terrified at the idea of a large grant for technical education because it may buy loyalty and secure peace.

Sir Harcourt Butler also believed that industrial education was a good antidote to political agitation. The gift of a crore of rupees for technical education from England to India was originally an idea of Chirol, the correspondent of The London Times, and Hardinge thought it an excellent suggestion. At the same time he wanted half a million pounds sterling, perhaps from cotton excise duty, to be earmarked for technical education. The Secretary of State, however, rejected the idea arguing that the British Cabinet would never agree to it.

India's industrial backwardness was revealed during the First World War when imports ceased and Indian mills and factories more increasingly called upon to meet growing war demands. The Industrial Commission put down the absence and misdirection of technical and industrial education as one of the significant causes for India's industrial under-development. It recommended a comprehensive scheme of technical education and a closer correlation between industrial education and local industries. It concluded that "the crying need of industrial India at the present time is the

provision of much greater facilities for the education of the artisan population...We have recommended the establishment of an efficient system of industrial education in special industrial schools under the control of the Department of Industries".

Local governments put forward various schemes for starting new institutes and expanding and improving existing ones. The Government of India sanctioned most of these. Government grants for technical education increased from Rs. 250,000 in 1905 to Rs. 1,500,000 in 1920. Yet the sum was not adequate to put technical education on a sound footing. The expenditure on this branch of education was bound to be high because of the expensive laboratory equipment and demonstration machinery required. While the average annual cost of educating a pupil in an art college in 1916-17 was Rs. 151-12-4, in a professional college it was Rs. 317-11-0. To make real advance in technical education a much larger expenditure was necessary than either London or the Finance Department were prepared to sanction. With a limited budget, it was not possible to start new technical institutes or equip the existing ones adequately. The Finance Member almost always opposed anything that might involve additional expenditure. Given the inelastic nature of the Indian revenue, expenditure on education of any kind was not likely to increase unless fresh sources of taxation were tapped or the defence budget reduced, neither of which was feasible under colonial rule.

The growth of higher technical institutions was linked to government employment and economic policies. As long as the superior services were reserved primarily for Europeans and private industries were foreign owned giving preference to foreign employees, there was not much point in encouraging Indian boys to go in for technical training. The absence of protective tariffs, the stores purchase policy, the close links between British business and officialdom and the foreign control over banking, insurance, shipping, etc., particularly in Eastern India was not conducive to the growth of Indian industries. The government did not adopt any positive measures to encourage the growth of Indian industries before 1920. Government efforts to develop the material resources of the country were largely limited to provision for improved methods of transport and irrigation.

The technical and industrial schools were in a poor condition, lacked competent direction and control, and were largely engaged in ~~work~~ teaching carpentry and smithy work to boys who never intended to be carpenters or blacksmiths, or to engage in any occupation whatsoever. These schools failed to attract sons of artisans who learnt the craft better and quicker at home from their fathers. For others, the training here was of doubtful value and employment prospects dim. In many cases the pupils found no suitable occupation in the trade they had learnt and had to turn to teaching others as little wanted as themselves.

Government was restricted by its own administrative machinery which was extremely complex and cumbersome. Before the Viceroy could decide on any policy measures he had to discuss it with his Council and obtain the views of the officials. The matter then had to be referred to the local governments who were chronically slow and characteristically conservative. Their replies had to be digested and their criticism considered; only then was a despatch drafted to the Secretary of State. A proposal coming from a local government was similarly critically examined by Delhi and if approved of, sent to London. Three weeks later the Despatch reached London where it was minutely discussed by the India Council, occasionally it was also referred to the Board of Education and often months lapsed before London replied. The Secretary of State's Council had control over expenditure which meant that no additional expenditure could be incurred without its sanction. The establishment of a technological institute at Kanpur was delayed by more than twelve years because London thought the expense too great. Every small matter regarding appointments, expenditure, etc., had to be referred by the institution concerned to the local government, by the latter to the Government of India, and finally to London. The whole process was extremely time consuming and dilatory.



Hence progress of technical education, despite all the reports and resolutions, committees and commissions, on the subject, was slow. As Curzon himself admitted, the "plant of technical education in India subsisted mainly on platitudes in viceregal and gubernatorial speeches."

### Post-Independence Period

The development of technical education has been one of the major achievements of the post-independence period. The creation of the All-India Council for Technical Education in 1945 and the Report of the Scientific Manpower Committee in 1947 had a far-reaching influence on this development. A further impetus was given by the Engineering Personnel Committee (1956) and the Committee for Postgraduate Engineering Education and Research (1961). The development of technical education as it relates to industry was promoted through the Apprenticeship Act (1961), the Industrial Training Institutes (ITIs) and junior technical schools at the skilled worker level and the spread of polytechnics at the technician level. Another significant factor that helped this development was the assistance received from friendly countries and international organizations in the form of scientific and technical equipment, services of expert professors in various branches of technology and facilities given abroad for the training of teachers. The first foreign aid for this was received from UNESCO in 1951

followed by the USA, the USSR, West Germany, Colombo Plan etc. All higher institutes of technology are receiving the benefit of such assistance. This system now provides a good basis on which to build and the tasks ahead are to determine the directions in which expansion is needed, to make full use of existing facilities, and to improve the quality of training.

Despite repeated exhortation, it is unfortunately still widely felt that vocational education at the school level is an inferior form of education, fit only for those who fail in general education and the last choice of parents and students. A concerted effort is needed by both Government and industry, through enlightened wage policies, vocational guidance and the education of public opinion, to promote the status and value of the skilled craftsman and technician.

Too sharp a distinction, however, must not be drawn between general and technical education. General school education should introduce children to the world of work and to an understanding of science and technology. Technology itself is evolving so rapidly that a student who receives only a narrow and specialized training, to the exclusion of general education in the sciences and humanities, will quickly find his skills obsolescent and lacking an adequate base for rapid retraining and ill-fitted for the complexity of the demands of the modern world. Therefore, while all

general education should contain some technical education of a pre-vocational nature, all technical education should also contain an appropriate element of general education.

In our view, the education system is not organized to provide to industry a product immediately ready to assume full occupational responsibility. Formal training even at the highest level, must always be completed by a period of practical training and internship within industry itself. A sound system of technical education results from a partnership between industry and the educational authorities. The training given within educational institutions must be linked directly with production, should be oriented to problem solving and ~~the~~ directed towards constantly improving instructional methods through professional contacts. Industry must accept to play its full share in the preparation of those who will later man its services by providing courses, cooperating in sandwich training schemes, making available facilities and staff for part-time teaching, assisting in the drawing up of courses of study, and making technical careers attractive. Technical education can be either institution-based with training completed within industry or industry-based with part-time education or re-training being provided by institutions.

Many engineering colleges in the country which are run by the State Governments have developed facilities for post-graduate ~~senior~~ education. The Government of India have established with foreign collaboration institutes of Technology at Bombay, Delhi, Kanpur, Kharagpur and Madras on the

recommendations of the Sarkar Committee appointed in 1945. These Institutes of Technology and the Birla Institute of Technology and Science, Pilani, are declared as Institutes of National Importance by an Act of Parliament and are empowered to award degrees. The Government of India have also helped to establish Regional Engineering Colleges in selected centres. The University of Roorkee is exclusively devoted to engineering education.

#### PURPOSE AND AIMS OF TECHNICAL EDUCATION

The aim of technical education, for that matter, all education, is to develop an integrated personality in every person so that he can lead a happy life in an environment of material comfort. In particular, technical education should aim at training well educated and cultured citizens equipped with a knowledge of modern science and technology, capable of skilled work, physically fit and healthy, and imbued with a spirit of patriotism. They should be devoted to their fellow citizens and ready to contribute through their work and their way of life both to the prosperity of the nation and to the cause of peace and amity among the nations. In addition, they should have the capacity to appreciate and have regard for moral values in life. Their minds should be capable of attuning themselves permanently to a state of happiness, no matter what depressing or elevating situations they may have to face in life.

Unfortunately, in this country, there is hardly any attempt either at training the student for rational thinking or for training the senses and the muscles for acquiring skill in work. The skill a student acquires should be such as to give him joy in the hours of his leisure and expertness in producing useful products. Those imparting instruction rely mostly on oral explanations and blackboard demonstrations without paying adequate attention to the training of the mind through concrete observations of natural phenomena and laws. Instruction has lacked close contact with practical life. Students hardly taste the joy of making things with their own hands, or of finding that the observations made of natural phenomena in their environment have proved correct. Mental and physical work should be complementary to each other.

Broadly speaking, technical education at all levels, particularly at the age group 7-14 years, should, apart from ensuring training in general citizenship as mentioned ~~in~~ ~~para 4~~ above concentrate on the fulfilment of the following objectives:

- (a) To train the mind in a rational way of thinking on any given problem and deducing conclusions in a scientific way.
- (b) To teach the art of planning in the use of natural resources for economic development, e.g., use of wind to develop power in villages, use of wood for industrial and housing purposes, use of earth for burning bricks, and so on.

- (c) To develop powers of observation in understanding how nature works and how machines work.
- (d) To develop manual skill in fabricating products.
- (e) To develop qualities of discipline to subordinate one's own inclinations to promote the general good of a community, group or the school, or the country itself; to develop qualities of leadership, initiative, capacity to obey, and such other characteristics which will promote social wellbeing of the individual, the community, the country and the world.
- (f) To use his leisure hours in the development of pursuits ~~which~~ which give him happiness and establish harmony and peace in his environment.

Apart from these general aims technical education should be purposeful. Each stage of technical education, craftsman, diploma and other stages, should be an end in itself so that students breaking off at any stage will be able to make a living from the technical skill they have acquired. They should promote technical development of the country instead of joining the army of the unemployed as the white-collared science and arts educated boys do, specially at the end of the middle school and the high school stages.

Although self-sufficiency is the aim at each stage of education, preference should invariably be given to those who have covered one stage to get admission to go to the next stage.

Curricula for studies should be drawn up with this end in view. This measure will result in giving new dimensions of respectability to craft and other technical education where there are none now. When once it is known that preference is given in admission to those who have already acquired a skill, almost all boys will then be attracted towards technical education so that the best amongst them can always be selected from the previous stage to the next higher stage. Those not selected for admission can earn their livelihood by the craft they have already acquired. The utter despair and the frustration which the S.S.L.C. and the P.U.C. boys now feel when denied admission to technical courses, and the anti-social traits they develop towards the community in general and the Government in particular will not then be there to the extent it is now prevailing.

#### STAGES IN TECHNICAL EDUCATION

At present, activities in spreading technical education may be confined to the following:

Giving technical bias to education at all levels, specially at the elementary school, so that mental and physical work supplement each other. Manual work will then gain new dimensions of respectability.

At present, young children in their classes read books on general science which adults find it difficult to understand. No wonder the science subjects are distasteful to our children.

These text-books have to be written emphasising not so much the content of science as the scientific (rational) way of thinking. The text-books should bring forth mostly the applications of science, like use of electricity for domestic lighting, working small tools used by carpenters and blacksmiths, etc., making and use of fertilisers for lands, and so on, the things with which the child is familiar in his environment. They should bring forth vivid descriptions of the way scientists have exploited natural resources like a waterfall, coal, wood, iron, clay and other materials for the benefit of man. The importance of basic education to the development of our economy cannot be overstressed. Basic education should be understood as the learning of skills to use modern aids to exploit natural resources.

Training of skilled craftsmen: These are the experts who can make any or all the components of an equipment or structure. Technical development to a very large measure depends on the skill of these man. They form the foundation on which technology is built. The training given to them has necessarily to be thorough. Since they form the bulk of the technical manpower of the country, careful and detailed planning is necessary for deployment of these forces in the required numbers, for the required types of jobs, to secure optimum efficiency in their utilisation. This problem of training skilled craftsmen is interlinked with the problem of creating gainful employment and preventing underemployment of the vast manpower available in the country.



Training of technicians of the foreman type for erecting, operating, and maintaining small groups of equipment, for example, as in a workshop: They should have thorough familiarity with the operation and maintenance of all the equipment they handle, coupled with an intimate knowledge of the know-how of erecting them. Training of master technicians involves giving a sandwich course where the student has both theoretical training and in-plant training in the plants or projects where they have to start and continue their professional career.

Erection and maintenance engineers : These are meant to specialise in the construction, management and operation of engineering complexes like river valley projects, steel projects, heavy electrical projects, and so on. Training for these men will necessarily have to be broad-based with accent on the practical side.

Design and development engineers : Training for these will be through a post-graduate course of two years. The training should be such that at its end they are in a position to design and develop either independently or working in a team, entirely new equipment based on the technical knowhow in the published literature on the relevant subjects or successfully copy and/or improve prototypes of equipment imported from abroad. This work in the present context of our development is so important that like the Russians, special courses for this purpose leading to conferements of both Master's and Doctoral degrees should be offered. Of the two years, the first year will have to be spent on learning the basic science and engineering subjects, and the second year mainly devoted to the preparation of a

design project, which should be defended before a Board of Examiners.

Industrialist engineers : These are trained for starting, developing and managing small-scale engineering industries. Training for these ~~men~~ men will have to be through a two-year post-graduate course or a three and a half year post-diploma course leading to the first degree in engineering. In the post-graduate course, the first year should be set apart to teach the elements of cost accounting, labour management, production engineering, marketing and sales promotion, materials purchase, handling and packing, advertising, and such other subjects. The second year of the course will have to be devoted entirely to the study of the design and manufacture of a particular product and submission of a design thesis which the student should defend before a Board of Examiners. In the post-diploma course, the first two years should be devoted to the study of the narrow speciality the manufacture of which interests the student. During the third year, the student should study the same subject as in the first year of the post-graduate course. The last six months of the course should be devoted to the preparation of a thesis devoted to a complete project for starting an industry in his locality. Although there is no such courses in other countries, our own country requires it. In Communist countries, the deployment

of technical personnel for starting various types of industries is planned well in advance and controlled entirely by Government. In capitalist countries, giant enterprises tend to act in the same way as governments in Communist countries in deploying technical manpower under their control for the starting or development of newer industries, auxiliary to their main interests. In India, we cannot enforce compulsion as do the Communist governments, nor do we have cartels which have monopolized industrial production in particular lines. In the social pattern of our objective, it will be necessary to deliberately plan a methodology for starting newer industries in specialized fields calling for a high degree of technical skill in planning, designing, production and marketing.

Engineering-scientists: These are to be trained so that they can give a lead and a direction to technical development. The number required for this work may not be very large but the quality of the work they do will have to be of the highest order. The training of these men should lead to the conferment of a doctorate. There may be five or more methods of taking up these doctoral conferments: (a) There may be an integrated course of five years for those who have taken a first degree in engineering, the first two years being spent mostly on learning the basic science subjects and the last three years in a special field of study. Research thesis should be a partial requirement for this type of course; (b) There may be an integrated course of six years

for those who have taken a first degree in science, the first three years being spent mostly on learning basic engineering subjects, one year on learning further basic science subjects, and the last two years in a special field of study. Research thesis should be a partial requirement for this course;

(c) There may be an integrated course of three years for those who have taken a post-graduate degree either as a design and development engineer or as an industrial engineer or as a management engineer. The first year of the course will be devoted entirely to the study of the basic science subjects and the other two years entirely to research on an engineering subject. Research is the main requirement for this course; (d) There may be an integrated course of four years for those who have taken their M.Sc. degree in science subjects. The course is the same as for those who have taken their first degree in science except they need not spend an additional year in learning the basic science subjects. Different degrees (D. Eng. and Ph.D) may be given to these categories, each degree denoting the stream through which the doctorate degree was obtained; (e) Any person who has a first degree in engineering or passed an equivalent examination like Sections A and B of the Associate Membership Examination of the Institution of Engineers (India) may submit a thesis either in the form of a design project or a research project for the award of a doctoral degree, after gaining experience for ten years in the profession. This is like an external degree examination such as that of the London University. He has to take written and oral examinations in the relevant subjects, and defend his original contribution in the nature of a design or a research project before a Board of Examiners. A separate degree D.Tech may be given to such persons.

Management engineers: These are the persons who should have a knowledge of both technology and management. The training for these men should lead to the award of a post-graduate degree

in engineering. Admission to these courses should be confined to those who have a minimum of ten years experience in the profession. The course will have to be of two years duration, one year being devoted to the study of relevant subjects like planning and layout of projects, industrial psychology, industrial economics, operational analysis statistical quality control, cost accounting, labour management, and other allied subjects. The second year should be entirely devoted to submission of a thesis on how the candidate proposes to improve the efficiency of any project in actual existence with which he has familiarity, or on any other problem of management. This should be defended before a Board of Examiners.

Extension activity to increase productivity in the rural and urban areas: These include the village agricultural labourer, carpenter, blacksmith, mason, and a host of others. Extension work may consist in holding course for a week or more to demonstrate the methods of increasing productivity or in the exhibition of feature films in weekly fairs jattras, melas, and other religious and commercial gatherings. Such other methods should be adopted by a separate organisation built up for this purpose. Since the number involved may exceed even twenty or thirty millions, the staff and other aids required for the purpose will be colossal. It should not be forgotten that even if the per capita income and the national income gets increased by a few rupees per each individual the sum total will be substantial.

Technical education for women at home : Their number runs to well over a hundred million. There is considerable underemployment amongst them. Suitable extension work will have to be evolved, so that they too can add both to their per capital income and to national wealth.

Extension work for those already in employment: Everybody should be given an opportunity to improve his learning from the lowest to the highest levels. With this end in view, correspondence courses, short refresher courses, seminars, and such other courses should be conducted. External degrees, diplomas, certificates, or other forms of conferment should be given to those who successfully undergo them. This is another very commendable method of increasing productivity with minimum cost.

Technical education for the physically handicapped: Courses to suit these will have to be drawn up and offered in institutes specially run for this purpose.

Other specialised courses : These are varied in type but the requirement of each type is very small. Examples of these types are, engineers specialising in designing and making surgical instruments and other requirements for medical men, engineers for designing and making aids for physically handicapped persons, engineers for designing and fabricating equipments required for sport, games and toys, engineers for designing and fabricating equipment for museums, exhibitions, and so on. These courses can be offered in industrialist engineer courses.

## MANAGEMENT OF TECHNICAL EDUCATION

Technical education system is not functioning in vacuum, but in an environment which is the total national setting. In this setting, the system is in close interaction with a complex of social, economic and political forces and these forces exercise varying degrees of influence on the different components of the technical education system. As these forces change in our national environment their influence on the technical education system also changes.

### Planning in Retrospect and Management

The process of analysis of the issues involved must necessarily start with **review** of how policies have been formulated and planning undertaken since both policies and planning constitute the national framework in which the technical education system has been established and developed. In 1947, at the time of independence, the Central Government set up a Scientific Manpower Committee to estimate scientific and technical manpower requirements over a ten year period and formulate a plan to train the manpower.

As we know, the Scientific Policy Resolution passed by Parliament in 1958 echoed these very objectives and emphasised the nexus between the human resource development and the imperatives of science and technology progress.

The groundwork prepared by the Scientific Manpower Committee shaped the subsequent events in three important ways. First, a national perspective on technical education emerged along with a clear role for the Central Government in coordinating and promoting technical education ~~the~~ in the country as a whole. Second, a manpower approach to the expansion and development of technical education was accepted in the national planning processes. Third, the All India Council for technical education, its Regional Committees and Boards of studies became the main national agency to advise the Central and State Governments on all aspects of technical education development. Three important factors influenced the pace and direction of progress of technical education in successive five year plans. In each plan the national perspective on technical education was elaborated and given an operation form and content. Development objectives were explicated in detail, specific schemes to fulfil the objectives designed and the areas of responsibility for the Central Government, State Governments and private agencies were delineated. Various methodologies were developed for estimating technical manpower requirements and the manpower estimates formed the basis for establishing new technical institutions as well as for expanding the capacity of existing institutions. As progressed from plan to plan, the national perspective extended from basic technological formation to advanced stages of technological R & D. As a sequel, facilities for post graduate studies and



research were created in the form of higher technological institutes (IITS) as well as in a network of engineering colleges. New directions continuously explored for heightening the efficiency and effectiveness of the total system.

### System in Operation

In all this development the role of the Central Government was crucial. By bringing State plans for technical education within the national framework and coordinating them the Central Government promoted balanced development throughout the country and gave unified direction to all States. It provided direct central assistance to supplement State resources and thus ensured that adequate instructional facilities were created and standards maintained by technical institutions. In addition to establishing and maintaining institutions of all India importance, the Central Government identified specific areas in which technical education should advance, designed suitable schemes and sponsored them as joint and cooperative enterprise of the Centre and States.

This is the process adopted in building up the system of technical education within a time span of 25 years. The system as it exists today comprises 180 engineering colleges. 370 polytechnics, five Higher Technological Institutes, three institutes of Management and several specialised institutions like Foundry and Forge Technology Institute, National Institute for Industrial engineering and four Regional Technical Teachers' training institutes.

The system produces each year about 30,000 graduates engineers, 40,000 diploma technicians and 500 prospective managers for industry and business. In addition, 3000 specialist engineers and technologists with the Masters' Degree and 300 doctorates are produced each year. The total investment in the system is about 1000 crore rupees on physical plant and equipment and the annual expenditure over 500 crore rupees.

### Effective Management of Resources

The prime function of Management is to 'manage' a system effectively and ~~efficiently~~ through a scientific process of design, development, implementation and evaluation. Effective management needs a thorough understanding of the system under consideration to achieve the desired objectives of the system. To manage efficiently, i.e. to attain the same objective with least cost, management has to make a conscious effort to optimise resources. The system's approach for effective management and optimisation techniques for enhancing the efficiency of the system are briefly described below.

#### 1. Systems concept.

The problems of effective management of resources can be effectively tackled by 'systems' approach which greatly facilitates our perception of a phenomenon, by looking at it in its totality. A system is the organisation of a process consisting of inter-related parts designed to transform a certain input from its environment into an output desired by the environment (2). The systems approach enables the

problem solver or designer to look at all the elements of the system simultaneously and perceive their inter-relationships more clearly, thus enabling design the process such that every component of the system and the system as a whole, is brought to a desired level of performance. The system maintains its adaptability through feedback provided by its environment and functions optimally through an inbuilt control mechanism. The conceptual models of a technical education system and that of a technical institution are explained in Annexure III.

2. Problem solving using systems approach

The problem of technical & vocational education can be basically classified under two heads.

- i) Quantitative Expansion : Designed to increase the reach of technical institutions so that the facilities are made available to a large group of the population and to special sections like women, physically handicapped, rural population etc.
- ii) Qualitative Improvement: Is an urgent requirement irrespective of any quantitative expansion envisaged. In the field of technical education, the need for qualitative development has not received due attention either from within or without the system. Many of the past and

present efforts concentrated on the quantitative expansion of the system only. Hence there is a need for all-out efforts for qualitative improvement. Management of resources, hence, requires an understanding of the basic concept of the systems' model outlined above.

### 3. Resource Management, general aspects.

The four management functions and the principles of resources management are outlined below.

#### i). Design

During the design stage, the system is developed as a conceptual model for complete analysis of the system elements, their characteristic and inter-relationship. In the design stage, the problem solver undertakes a detailed project formulation activity to delineate the various aspects of the system either for its expansion or improvement. The major steps involved in the project formulation are:

- i) General Information
- ii) Need Analysis
- iii) Problem Definition
- iv) Objectives
- v) Strategies and activities for implementation

- vi) Time Scheduling
- vii) Resource Requirement
- viii) Budget
- ix) Significance of the Project
- x) Evidence of Capability

While the above steps form part of the detailed system design, main concern now is with the resources, planning of which is described below:

**Planning of Resource:** Resource planning is undertaken after the objectives, strategies and time schedule of the project are determined. Resources are planned under three main heads, viz., Physical Human and Informational.

- (i) **Physical Resources:** Some major consideration in the planning of physical resources are norms and standards, utilization factor, spatial design & organisation, pedagogical considerations, sources of supply and cost, use of resources from other system, optimization techniques for space and equipment utilization, etc.
- (ii) **Human Resources:** Planning of human resources should be based on the factors like job design, competencies, job aids, staff development, career development, recruitment procedures etc.

- (iii) **Informational Resources:** Information resources should be designed considering factors like, Identifying user profile, resource personnel and infrastructure requirements, support services and interaction of human and information resources, etc.

## II. Development :

Development is the process of acquiring and organising resources. The fundamental considerations during the development stage are:

- (a) **For Physical Resources :** Acquiring space, constructing buildings and other amenities, acquiring and installing equipment, furniture etc., procuring consumables and raw materials, developing schedules for maintenance etc.
- (b) **For Human Resources :** Recruitment, identifying gaps in knowledge and skills, organizing initial and inservice training of personnel, developing staff appraisal schemes, preparing career development plan etc.
- (c) **For Information Resources :** Identifying information resources, preparing resources in appropriate format, developing criteria for validation etc.

### III. Implementation

The function of management at this stage is to facilitate the interaction of input with the physical, human and information resources so that the process takes place as per design. The management also collects data regarding the process through formative evaluation. The techniques used by the management for enabling the process to take place are:

- (a) Coordination to ensure that individuals, teams and departments work towards common goals set for the programmes, for timely deployment and effective utilisation of resources and for proper maintenance.
- (b) Buffering techniques to take care of uncertainties in the design assumptions with reference to input, resources, processes and output.
- (c) Bridging techniques to ensure development of effective linkages between individuals, teams and departments and with the environment.

### IV. Evaluation

The first stage of evaluation is the monitoring during implementation which continues throughout the duration of the project and accumulates data for final evaluation. During this stage, many corrective measures can be undertaken both in the quantitative and qualitative aspects of resources utilization. At different

stages of completion of a project/programme, a summative evaluation of the project can be undertaken. The various aspects like planning, development and implementation can be reviewed at this ~~xx~~ stage and can be used in subsequent stages/projects for increasing the effectiveness and efficiency of management. Systematic methods of evaluation should be planned and combined effectively for objective and purposeful evaluation.

#### Optimization of resources

Various methods for resource general outlined earlier, ensure availability of adequate financial resources to provide for physical, human and information resources for technical education. Besides, planning and development of the ~~xx~~ resources using systematic project formulation strategies and suitable optimization techniques outlined earlier, the following points are important in effective management of specific types of resources.

##### 1 Physical Resources

Substitution and miniaturisation : Innovative use of models and simulations can be used to learn concepts, principles and procedures more effectively in place of costly prototype equipment. Also cheaper alternatives can be used with the same instructional value.

##### Preventive maintenance and timely repairs:

Minor repairs and maintenance can be done by the institution ~~itself~~ itself, if interdepartmental coordination can be ensured. The repair and maintenance are very crucial in areas of sophisticated technology. The central facilities



for repairs available at institutes like IITs, TTTIs, ATIs, CTIs must be made maximum use of by technical institutions.

Increased use of physical resources can be achieved by

- (i) Conducting multiple shifts and part-time courses:  
The institutions can also conduct short-term programmes for updating and upgrading of technical knowledge and skills.
- (ii) Sharing of costly resources among institutions situated in the same neighbourhood : Also industry can be approached to donate used machinery for training of students.
- (iii) Making more use of vertical space: Leading to reduction space.
- (iv) Using industrial and community resources:  
For education and training. This also helps in better linkages with the use system.

Physical resources of the institutions like space and equipment can also be put to productive use for services to industry and community around.

## 2 Human resources

Human resources are the costliest and also the most important. Some of the important points in their efficient management are: Faculty time must be made use of, for more creative and productive activities related to instruction. It is also essential to provide adequate supporting, technical and administrative staff. Efforts must be made to increase the number of working days in a semester/year.

It is necessary to increase the reach and range of faculty, by use of modern communication methods. Faculty competency can be increased by:

- (i) Systematic faculty development through initial and inservice training must be accepted as a policy and planned in advance.
- (ii) Suitable practical training programmes in industry, exchange of faculty and industry personnel and consultancy work by faculty must be encouraged and supported.
- (iii) Innovative efforts of faculty in technical education must be encouraged.

It is necessary to match to the extent possible, the institutional requirements of faculty development with individual aspirations of growth of faculty members. The training programmes must be supplemented by self-study and continued learning of faculty, for which they should be trained in independent study and continued learning skills.

### 3. Information Resources

The important information resources are curriculum document and instructional material, print and non-print. Periodic review of curriculum should be a built-in feature.

Instructional material is a resource as important as faculty. It consists of print material (text-book, laboratory

manual, data book, work book, teacher guide, student guide etc.) and non-print material (slides, film strips, charts, models, realia, audio cassettes, video films etc.). Systematic development of comprehensive instructional material (print and non-print) must be taken up as a major activity by the technical institutions by:

- (i) Faculty involvement in instructional material development must be encouraged and recognised.
- (ii) Strengthening of library and audio-visual centres to give professional help in instructional material development and later, in the dissemination of information regarding instructional material.
- (iii) Suitable support facilities  
Effective management of physical, human and information resources, require a lot of guidance and support from an enlightened and committed management. The principal and heads of department have to provide inspiring leadership for change and development in the institution. A culture for accepting and effecting change and introducing creative innovations must be developed by such a leadership, which will also set in a machinery for performance evaluation with maximum emphasis on improvement.

#### 4. Management for planned change

Technical and vocational education has to change fast. Hence management of resources must be coupled with management for change in a planned way.

All the methods mentioned above set a stage for problem-solving actively in the user system. But user system cannot do this without additional components of Educational Technology, Curriculum Development and Information Technology. Hence necessary linkages must be established with resource systems like TTI to assist in a problem solving activity. Establishment of each resource system and linkage with the system is vital.

#### ANNEXURE I

##### Inter-sectoral Allocation for Education during the Five Year Plans in Crores Rupees

Educational Level	First Plan	Second Plan	Third Plan	Fourth Plan	Plan 'Fifth ' Sixth Plan Holi- Plan day		
Elementary*	85 (56)	95 (35)	178 (30)	65 (20)	235 (29)	410 (32)	906 (36)
Secondary	20 (13)	51 (19)	103 (18)	53 (16)	118 (14)	250 (19)	398 (16)
University	14 (9)	48 (48)	87 (15)	77 (24)	184 (22)	292 (23)	486 (19)
Other** (General)	14 (6)	30 (10)	116 (16)	46 (15)	161 (20)	140 (10)	457 (18)
Total- General	113 (87)	224 (82)	484 (79)	241 (75)	697 (85)	1092 (85)	2247 (89)
Technical	20 (13)	49 (10)	125 (21)	81 (25)	125 (15)	156 (12)	278 (11)
Grand Total	153 (100)	273 (100)	589 (100)	322 (100)	823 (100)	1285 (100)	2524 (100)

Figures in brackets are percentages to total.

Note: \* including pre-school education.

\*\* including teacher education, social education (youth services), cultural programmes etc.

ANNEXURE II

Percentage distribution of education expenditure  
by sources (1950-51 to 1978-79)

Year	Govt. funds	Local Bodies	Private Sources	Fees
1950-51	57.1	10.9	11.6	20.4
1967-68	71.9	5.5	8.2	14.4
1968-69	73.3	4.8	7.8	14.1
1969-70	75.6	3.7	7.4	13.3
1970-71	75.6	4.4	7.2	12.8
1971-72	73.0	N.A.	N.A.	N.A.
1972-73	76.5	N.A.	N.A.	N.A.
1974-75	80.4	N.A.	N.A.	N.A.
1975-76	78.5	N.A.	N.A.	N.A.
1978-79	80.5	5.0	3.0	12.0

N.A. Not available.

ANNEXURE III

Technical Education System

The technical education system at state level is shown in Fig. 1. The basic components of the system are:  
i) Input ii) Process iii) Output iv) Control mechanism and v) Environment. In the above model, technical institution can be ITIs, Junior Technical Schools, Poly-

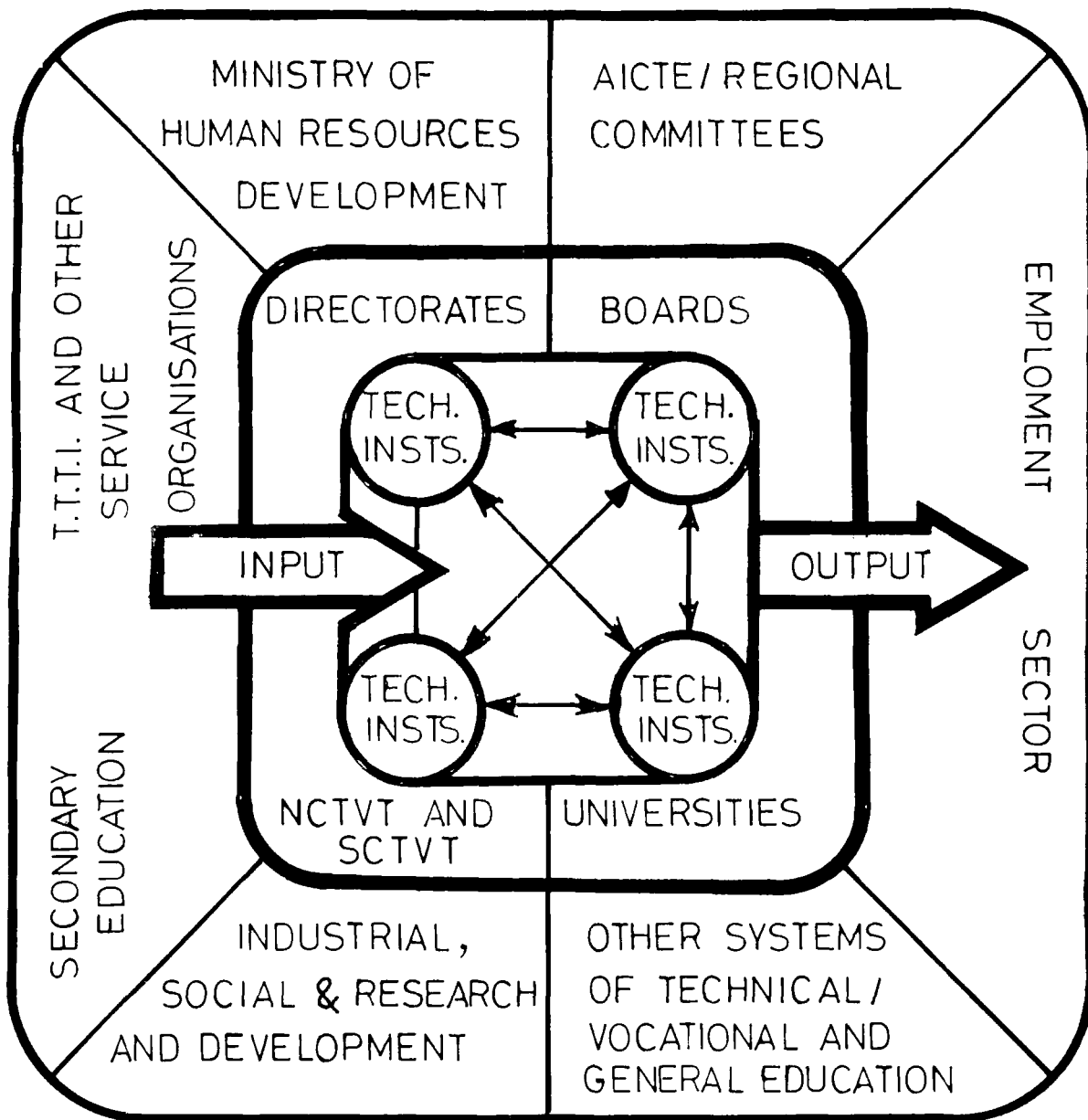


FIG.1:— TECHNICAL EDUCATION SYSTEM ENVIRONMENT

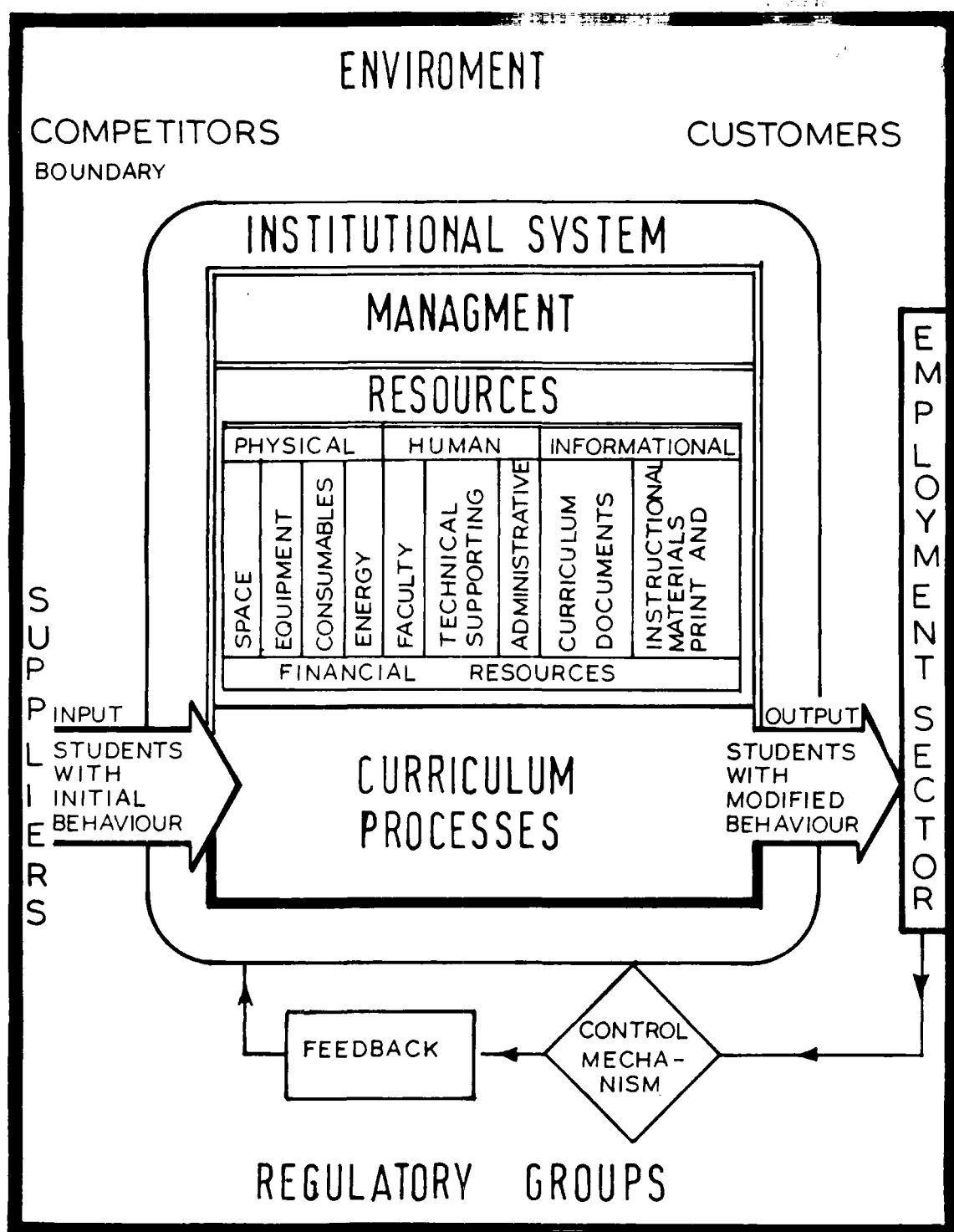


FIG.II : INTERPRETATION OF SYSTEM CONCEPT  
TO A TECHNICAL INSTITUTION

technics and Engineering Institutions offering courses at degree level and above. The figure is self-explanatory as far as the system's environment is concerned.

## 2. Technical Institutional System.

2.1 The institutional system model is shown in Fig. 2. The different components of the system are described below.

- Environment - Of a technical institution system consists of customers (Industry and Society), suppliers of input and resources, other educational systems and regulatory groups like Ministries, DTE, BTE, AICTE etc.
- Input - to the system can be students with 8 + 10 + or 12 + qualifications, from other lower technical institutions and the work force already in employment.
- Output - of the system are students with the stipulated knowledge, skills and attitudes necessary for performing specific functions listed as objectives of the programme.



## NATIONAL POLICY ON TECHNICAL EDUCATION - 1986

The following major steps are as follows:

- 1) The infrastructure and services sectors as well as the unorganised rural sector also need a greater induction of improved technologies and a supply of technical and managerial manpower. This will be attended to by the Government.
- 2) In order to improve the situation regarding manpower information, the recently set up Technical Manpower Information System will be further developed and strengthened.
- 3) Continuing education, covering established as well as emerging technologies, will be promoted.
- 4) As computers have become important and ubiquitous tools, a minimal exposure to computers and a training in their use will form part of professional education. Programmes of computer literacy will be organised on wide scale from the school stage.
- 5) In view of the present rigid entry requirements to formal courses restricting the access of a large segment of people to technical and managerial education, programmes through a distance-learning process, including use of the mass media, will be offered. Technical and management education programmes, including education in polytechnics, will also be on a flexible modular pattern based on credits, with provision for multi-point entry. A strong guidance and counselling service will be

provided

- 6) Appropriate formal and non-formal programmes of technical education will be devised for the benefit of women, the economically and socially weaker sections, and the physically handicapped.
- 7) The emphasis on vocational education and its expansion will need a large number of teachers and professionals in vocational education, educational technology, curriculum development, etc. Programmes will be started to meet this demand.
- 8) To encourage students to consider "self-employment" as a career option, training in entrepreneurship will be provided through modular or optional courses, in degree or diploma programmes.
- 9) In order to meet the continuing needs of updating curriculum, renewal should systematically phase out obsolescence and introduce new technologies or disciplines.
- 10) Some polytechnics in the rural areas have started training weaker groups in those areas for productive occupations through a system of community polytechnics. The community polytechnic system will be appraised and appropriately strengthened to increase its quality and coverage.

Promoting Efficiency and Effectiveness at all Levels:

As technical education is expensive, the following major steps will be taken for cost-effectiveness and to promote excellence:

- i) High priority will be given to modernisation and removal of obsolescence. However, modernisation will be undertaken to enhance functional efficiency and not for its own sake or as a status symbol:
- ii) Institutions will be encouraged to generate resources using their capacities to provide services to the community and industry. They will be equipped with up-to-date learning resources, library and computer facilities:
- iii) Adequate hostel accommodation will be provided, specially for girls. Facilities for sports, creative work and cultural activities will be expanded:
- iv) More effective procedures will be adopted in the recruitment of staff. Career opportunities, service conditions, consultancy norms and other perquisites will be improved.
- v) Teachers will have multiple roles to perform: teaching, research, development of learning resource material, extension, and managing the institution. Initial and in-service training will be made mandatory for faculty members and adequate training reserves will be provided.

Staff Development Programmes will be integrated at the State, and coordinated at Regional and National levels.

- vi) The curricula of technical and management programmes will be targetted on current as well as the projected needs of industry or user systems. Active interaction between technical or management institutions and industry will be promoted in programme planning and implementation, exchange of personnel, training facilities and resources, research and consultancy and other areas of mutual interest.
- vii) Excellence in performance of institutions and individuals will be recognised and rewarded. The emergence of substandard institutions will be checked. A climate conducive to excellence and innovation will be promoted with full involvement of the faculty.
- viii) Select institutions will be awarded academic, administrative and financial autonomy of varying degrees, building in safeguards with respect to accountability.
- ix) Networking systems will have to be established between technical education and industry, R & D

organizations, programmes of rural and community development, and with other sectors of education with complementary characteristics.

#### THE FUTURE

The future shape of Technical Education in India is too complex to envision with precision. Yet, given our tradition which has almost always put a high premium on intellectual and spiritual attainment, we are bound to succeed in achieving our objectives.

The main task is to strengthen the base of the pyramid, which might come close to a billion people at the turn of the century. Equally, it is important to ensure that those at the top of the pyramid are among the best in the world. Our cultural well-springs had taken good care of both ends in the past; the skew set in with foreign domination and influence. It should now be possible to further intensify the nation-wide effort in Human Resource Development, with Education playing its multifaceted role.

P A R T   T W O

( BIBLIOGRAPHY )

LIST OF ABBREVIATIONS USED

April	..	..	Apr
And	..	..	&
August	..	..	Aug
December	..	..	Dec
February	..	..	Feb
January	..	..	Jan
July	..	..	Jul
June	..	..	Jun
March	..	..	Mar
May	..	..	May
Monsoon	..	..	Mon
November	..	..	Nov
October	..	..	Oct
September	..	..	Sep
Spring	..	..	Spr
Winter	..	..	Win

LIST OF PERIODICALS ABSTRACTED

ASCI Journal of Management  
British Journal of Teacher Education  
Capital  
Chemical Age of India  
Commerce  
Eastern World  
Education Quarterly  
Educational India  
Educational Review  
Fortnightly Journal of Industry and Commerce  
Haryana Review  
Indian and Foreign Review  
Indian Chemical Engineer  
Indian Educational Review  
Indian Journal of Industrial Relations  
Indian Journal of Power & River Valley Development  
Indian Journal of Technical Education  
Indian Management  
Indian Railways  
Industrial Economist  
Industrial Engineering & Management  
Industrial Engineering Journal  
Industrial India



Industrial Times

Integrated Management

International Journal of Mathematical Education  
in Science & Technology

Irrigation & Power Quarterly

STD Review

Journal of Education & Psychology

Journal of Indian Education

Journal of Higher Education

Journal of Social Psychology

Lok Udyog

Mainstream

Manpower Journal

March of Mysore

New Administrator

NIE Journal

Personnel Management

Productivity

Progress of Education

Prospects

Publisher's Monthly

Quarterly Review of Historical Studies

Rajasthan University R News

Religion & Society

Technical Teacher

Times Weekly

University News

Yojana

News Papers

Economic Times

Frontier

~~Indian Express~~

Hindu

Hindustan Times

Indian Express

Patriot

377	Vocational, Technical Education
377(083.4)	Survey of Technical Education
377(091)	History of Technical Education
377.001.5	Technical Research
377.001.6	Development of Technical Education
377.001.7	Improvement of Technical Education
377.001.8	Importance, Utility of Technical Education
377.003.2	Technical Education Cost
377.007.6	Consultancy Service in Technical Education
377.008	Organisation of Technical Education
377.014	Policy of Technical Education
377.014.542	Planning of Technical Education
377.112.4	Teachers, Instructors
377.112.6	Teacher Training
377.121.2	Admission Test in Technical Education
377.121.4	Prospectus, Curriculum, Syllabus of Technical Education
377.127	Examination in Technical Education
377.194	Problem in Technical Education
377: 331.024	Technical Manpower
377:338.45	Technical Education for Industrial Production
377:374.2	Group Study & Discussion
377:420	English Medium in Technical Education
377:65.0018	Role of Industry in Technical Education
377:772.2	Blue Print in Technical Education
377.5:62	Technical Education in Engineering(general)
377.5:62(021)	Handbook of Engineering Education
377.5:62(091)	History of Engineering Education

377.5:62.001.5	Research in Engineering Education
377.5:62.001.7	Improvement of Engineering Education
377.5:62.001.8	Importance in Engineering Education
377.5:62.003.2	Engineering Study Cost
377.5:62:338.93	Entrepreneurship for Engineers
377.5:62:371.212	Admission in Engineering
377.5:62: 371.214	Curriculum Syllabus for Engineering Education
377.5:62:371.27	Examination in Engineering Education
377.5:62:371.3	Engineering Method of Instruction
377.5:620.9	Energy Education
377.5:621	Mechanical & Electrical Engineering Education
377.5:65	Management, Organisation of Industry
377.5:66	Chemical Industry Education
377.5:678	Polymer Science Education
377.5:681.3	Computer Science Education
377.5:781.6	Instrumentation Education
378.6	Higher Technical & Vocational Education.

377 Vocational, Technical, Professional  
Training : School, College Institute.  
Polytechnics

1 GOVINDA RAO (C V).

Vocationalisation of Education.

Education Quarterly. 29, N4; 1978, Jan; 19-21.

The chief aim of vocational education is to prepare the youth for employment. All those who pass the vocational courses cannot expect to get employment in various selectors. It is necessary that their training should inculcate in them a high degree of skill and knowledge and courage to venture upon independent jobs. There are a variety of vocational institutions currently running in different areas. It is therefore desirable to start only such new courses for which training facilities are not available. The National Council of Educational Research and Training proposed that vocationalisation should be introduced in the 11th and 12th standards and that 50% of the students should be diverted to vocational streams which have promising employment potentialities in the immediate future. In any educational system the teacher plays a pivotal role and it is much more so in vocational subjects. He should be chosen without meaninglessly sticking to the outdated concepts of prescribing university degrees as the appropriate qualifications. The success of vocational courses depends upon the immediate employment opportunities. These are related to rapid strides in economic development. There should also be a social commitment in the matter of providing training facilities, infra-structural and financial

support for self-employment. The professional organisations should change their attitudes from one of rigidity to that of flexibility. It is the duty of the older generation to encourage, support and promote the careers of the youngsters without sacrificing the legitimate interest of industry or business. The academic institutions, the industrial enterprises, hospitals, hostels, progressive farmers etc. must cooperate for mutual benefit and the future growth of the country's human resources.

HATEKAR (DJ).

Job-oriented education.

Yojana. 1970, Jul. 12; 27.

Companies seldom adopt the best form of work organization to suit the work force or to maximise production efficiency. In this paper a strategy for job change and improvement is outlined. The training implications of change programmes, with alternative methods of working and work organisation are considered. The advantages of job reform and re-designing of jobs to meet the needs of the individual are discussed. Job rotation enlargement and enrichment are defined and their training implications considered. Autonomous work groups are described and the skills required for this type of working are discussed.

RAJAGOPAL (MV).

Technical studies in flux.

University News. 14, N1; 1976, Jan.; 20-1.

This article explains that Technical education is and will continue to be very expensive as contrasted with general education

## 4 RAMAKRISHNAN (A).

Technical qualification: Gap between study and career.

University News. 16, N20; 1978, Oct. 15; 1213.

Gap problem between study and career are being discussed and solution also given that the Government of India has a scheme under the apprentices Act 1973 where the emerging engineers/technicians are given a chance to get themselves familiarised with Industry and Industrial life.

## 5 SHARMA (A).

Available technical potential at the data level.

Indian Educational Review; 6, N2; 1971, Jul. ;1982-95.

A study was undertaken to assess the supply of technical potential at the delta level (class VIII) in the boys' secondary schools of Delhi. Other aims were to study the effect of urban and rural environments on the development of technical potential, to determine the loss of this potential through failure to secure technical education and to diagnose the causes of this loss with a view to remedying them. A battery of mechanical aptitude tests consisting of the i) mechanical knowledge test, ii) mechanical comprehension test, iii) space relations test, iv) form relations test, and v) mechanical adaptability test, was used for conducting the survey. The sample consisted of 1093 students of whom 934 belonged to urban area and 159 to rural area. A major finding is that only 14.55% students are potential material for higher technical education and subsequent technical jobs.

The rural contribution is 1.10% in comparison to the urban contribution of 13.45%. It is suggested that, among other things, simple machines, their principles and functions may be taught at the delta level.

6 TAHSIN (M).

Job-oriented technical education.

Yojana. 1972, Aug. 1; 549, 551.

Technical education in India is in a four tiered structure comprising (1) Postgraduate course and research, (2) Degree courses, (3) Diploma courses, and (iv) Vocational or Industrial training, and are being discussed.

377 (083.4) Survey

7 CULSHAW (MJ).

CSI Survey on technical and vocational training.

Religion and society. 18, N4; 1971, Dec.; 70-6

In this article a description is given regarding technical and vocational institutes where technical training are conducted in all over the India.

8 MOHAN (V) and VOHRA (HBL).

An investigation of patterns of vocational choices of polytechnic students.

Indian Journal of Technical Education. 7, N1; 1981, Apr.; 16-22.

An analysis of results of students admitted in Polytechnic are being calculated in this article.



- 9 NAFDAY (Avinash).

Urban surveys with aerial photography-education training and research requirement.

Indian Journal of Technical Education. 5, N1; 1977, Apr./Aug.; 11-3.

Application of Remote sensing techniques as a tool for urban data collection are being studied.

- 10 NAYAR(BK).

Indian Students and trainees in Scientific and Technical Fields who went abroad during 1965-75.

Journal of Higher Education. 4, N2; 1978, Aut; 171-86

Statistical data of Indian Students in developed countries for advanced study, training and especially in technical field are being calculated.

- 11 SIVALINGAM (P).

Technical education and job opportunities

Economic times. 1981, Aug. 14; 4.

Statistical calculation is given to show that job opportunities is higher for technical educated students with comparison ~~with~~ of other fields.

### 377 (091) History

- 12 BARUAH (SK) and ADITYA KUMAR.

Technical and scientific training facilities in India.

Indian and foreign review. 1976, Jun, 1; 18-20

Historical description of technical and scientific facilities in India during pre and post independence periods are being discussed.

13 DAMODARAM (GR).

Technical education in India: Looking back and forward.  
Education Quarterly. 24, N4; 1973, Jan,; 5-9.

A review of development - Phenomenal expansion are being explained and suggested that Engineering education is function-oriented and has to keep pace with rapid changes and developments constantly taking place in technology and Industry.

14 GARG (RK).

Technical Education in the seventies.

Indian Journal of Technical Education. 3, N2; 1974, Dec.; 77-80.

The decade of the seventies is a crucial stage in the history of technical education in India due to rapid development in Engineering and technology are given new dimensions to technical education. These aspects are being explained in this article.

15 NAYUDAMMA (Y).

Technical Education and rural development.

Indian Journal of Technical Education. 5, N2; Dec. 1977/  
Apr. 1978; 67-71.

The main aim is to develop education interlinked to the process of such development local, social, political

economics, environment, governments in rural area.

16 PROGRESS OF Technical Education in India.

Industrial India. 27, N3; 1976, Mar., 35.

It has been explained a notable growth of technical education in India during the last twentyeight year. Consolidation of existing facilities and reorganization of courses for training engineers, technicians with a view to improve the quality and standards continue to be the key note of the activities in the field of technical education in India are also been explained.

17 SINGH (RP).

Professional Education in ancient and medieval India, Delhi. Arya Book Depot, 1970; III, 146.

The book is divided into two sections, the first dealing with the ancient period and the second with the medieval period. In both the periods, professional education such as for priesthood, teaching, medicines, law, architecture and engineering and vocational education for trades and crafts have been dealt with.

18 TECHNICAL EDUCATION Since Independence.

New Administrator. 9, N1; 1970; 60-3.

The background of commercial education is traced in this article since independence when increasing continental rivalry in trade created a growing need for young man who had both technical and commercial training.

## 377.001.5 Technical Research

19 YADAN (MS) and MENON (SB).

Research needs in technical education.

Journal of Indian Education. 6, N4; 1980, Nov., 17-22.

The need for research in technical education had been stressed. In fixing of priorities, the following criteria have to be kept in view;

- 1) Manpower requirements
- 2) Validity of past policies
- 3) Resources available for the research. It is pointed out that technical education cannot have areas of research independent of other disciplines. The following areas of the research in technical education have been enumerated: (a) theory, (b) planning (c) curriculum (d) evaluation (e) administration (f) practical class room problem. Research can be enumerated topic-wise also.

## 377.001.6 Development

20 BARUAH (SK)

Professional education in changing technology.

Industrial India. 27, N9; 1976, Sep.; 21-6

During the last decade there has been a tremendous social and technological change and a tremendous increase in the growth of professions in response to this change

so students and young practitioners to call for a re-thinking of professional roles. In those new roles the professional is asked to challenge some of the norms of his own profession and to light the bureaucratisation and standardization that have occurred in many professions.

21 **DEVELOPMENTS IN Technical Education.**

University News. 10, N5; 1972; 4-5.

The All India Council for Technical Education which held its 21st meeting on April 21, 1972 accepted the following recommendations made by a conference of the State Directors of Technical Education: (1) every State should set up a State Board of Technical Education on a statutory basis for a) coordinated development of polytechnic education, b) continuous evaluation of standards, c) holding of examinations and award of diplomas; 2) under the joint auspices of each Board and Regional Committee of the AICTE, there should be a standing Evaluation Committee to inspect the polytechnics and to suggest measures for improvement; 3) this Board should establish close cooperation and coordination with industry so as to train the right type of technicians. Some of the other important decisions are: 1) setting up a committee to take an overall view of the present state of all private technical

institutions in the country; (2) establishing a Central Institute of Printing Technology; 3) extending the duration of the course in Architecture to integrate one year practical training with it; 4) permitting the staff of the Schools of Architecture to undertake consultancy work; 5) providing cent per cent Central grant for a minimum period of ten years to institutions approved by the Board of Management Studies; 6) instituting an expert committee to review and modify the selection procedures in technical institutions and a Joint Committee of the UGC and the AICTE to review the whole system of engineering education at the first degree level.

## 22 NEW ORIENTATION to Technical Education.

Educational India. 37, N 10; 1971, Apr. 347-9.

A seminar was held at IIT, Madras on Jobless Engineers and put forwarded a plea for the re-orientation of technical education.

## 23 RUDRABASAVARAJ (MN).

Executive Development system.

ISTD Review. 1, N6; 1971; 11-5.

The several points that are relevant to the need and the problem of executive development have been mentioned. Some of the major objectives of management development are: 1) to assure managers in required numbers and with the required skills to meet the anticipated future

needs of business; 2) to encourage managers to grow as persons and their capacity to handle greater responsibility; 3) to improve their performance at all levels in the jobs they now hold; 4) to sustain good performance throughout their careers. The executive development programme is not merely a programme. It is a system with closely interrelated phases of activities involving three sets of characters -- the company, the executive and the school. The role of these three characters have been discussed.

24 SHANTAMALLAPPA (BL).

Recent development in technical education.

March of Mysore. 8, N10-1; 1971, Oct./Nov.; 29-30.

This article comments upon two new developments taking place in the field of training. These developments are (1) reappraisal of the national manpower and training system, (2) reappraisal of training of trainers.. Managing manpower resources and providing fulfilling work experiences for people is now one of the most important aspects. To achieve this the national interest requires some mechanism for producing an agreed and acceptable policy.

## 377.001.7 Improvement

CHIRANJI LAL.

Promotion of technical education in Haryana.

Haryana Review. 8, N9; 1974, Oct. 10-1.

Discussion on the development of analytical instruments to identify common skills across a range of occupations and the need ~~of~~ to provide appropriate learning experience to assist young people. It is also likely that continuous use of skills and opportunities for their development to suit changing circumstances may be equally important in determining people's ability to make the transfer to different type of job and cope with the associated training.

26 DESHPANDE (RD).

Scientific and Technical Education; Steps to improve quality and extend scope.

Economic political weekly. 1972, Aug. (Spl); 1661-66.

An attempt has been made to identify some of the steps which could be taken by the Central and State Governments and Universities to more effectively utilize the existing facilities for scientific and technical education. The success ~~of~~ these efforts would depend on proper planning and identification of suitable institutions and personnel for their execution.



27 DEVELOPMENTS IN Technical Education.

University News. 10, N5; 1972, May; 4-5.

The basic ~~ba~~ aims are: 1) to set up a state board of technical education on a statutory basis with express purpose of ensuring coordinated development of polytechnic education, continuous evaluation of standards, holding of examinations and award of diplomas, 2) Evaluation of a standing committee to inspect the polytechnics on a regular basis and to suggest measures for improvement and development; 3) This board should establish close cooperation and coordination with industry ~~so~~ as to train the right type of technicians.

28 DATTA (M) and NIYOGI (S).

Improvement of Technical Education in India.

Journal of Indian Education. 7, N4; 1981, Oct.; 42-5.

This article describes how the curriculum for technician training should be modernized to face the challenge of fast changing technology in developing countries.

29 KHANIJO (MK).

Diversification of technician education.

Education Quarterly. 37, N4; 1985, Win., 22-7.

Restructuring and development of an appropriate model of technician education related to such areas as a practical training, infrastructure, teachers, finance and organisational arrangement are being studies.

30 KHOBRAGADE (NT).

Polytech education.

Indian Journal of Technical Education. 7, N1; 1981, Apr; 3-6.

It has been a phenomenal expansion in polytech education during the last thirty years. Meaningful planning of polytech education will enhance the qualities like efficiency dynamism etc. This can only be achieved by adopting improvement programme.

31 KHURAIISHI (SA).

Polytechnical education in GDR: Its relevance to work experience programme in India.

Indian Educational Review. 11, N4; 1976, Oct; 109-14.

The conditions for the implementation of the programmes working conditions, human relationship and the disciplined approach facilitate the successful completion of the programmes are being explained.

## 32 NEW IDEAS for Technical Education.

Hindu. 1972, Apr 25; 6.

The new proposals made by Tamil Nadu Technical Education Board are as follows: 1) introducing new subjects such as marine engineering, nautical architecture, nuclear engineering and design and automotive engineering in Guindy Engineering College; 2) installing a testing centre for automobile components in Madras and a testing laboratory for all forms of instruments at Coimbatore for giving students a practical orientation; 3) establishing a technological university with head quarters at Guindy College and affiliating six other institutions in the State; 4) introducing aeronautics, plastic and rubber technology and dairy engineering, prosthetics, pharmacy, data processing and diesel traction subjects in polytechnics; 5) conducting sandwich courses in textile technology; 6) setting up a board consisting of industrialists and educationists to plan new courses and to study the problems of training engineers for specific careers. The Central Government is encouraging reorientation of technical education and is financing the Institutes of Technology and the Regional Colleges of Engineering. As the States have realised the difficulty of financing higher education, the Centre should estimate numbers and types of engineering personnel needed for the planned development of the country and promote technical education.

- 33 REVIEW OF Study in Polytechnics recommended.  
Patriot. 1971, Jun 2; 5.

A committee appointed by the Government of India to review the system of polytechnic education in the country. Polytechnic education should develop in the students practical skills through laboratory work, workshop practice and project work.

- 34 SELVARAJAN (N).

Team—Teaching: An Innovation in Education.

Indian Journal of Technical Education. 2, N2; 1972,  
Dec; 64-6.

Recognized and acknowledged the fact that the greatest contribution of team teaching is in improving the teaching learning process and this is not likely to occur without the appreciation, understanding, support and whole hearted cooperation of the teachers concerned.

- 35 SEN (B).

Inspection to Improve Technical Education: What it Means.  
Education Quarterly. 22, N2; 1970, Jul; 29-33.

The State inspection staff should not only inspect the Institute but to evaluate their performance. ~~but~~ They should also bring to the notice of the teachers and the principal, the latest methodology of teaching, teaching aids used etc. adopted by the other States

The main purpose of this paper is to draw the attention of all concerned to the importance of the inspection organization in the quality improvement of technical education in India.

36 SUNDARAM (S).

An approach to the development of technical education.  
Indian Journal of Technical Education. 3, N3; 1975, Apr;  
101-4.

Technical education has undergone a remarkable expansion in India since 1947. The number of graduate engineers increased from 1,270 in 1947 to about 15,000 in 1970. An statistical calculation are being discussed.

37 TOHSIN (M).

An Appraisal of evaluation methods in technical education.  
Indian Journal of Technical Education. 2, N2; 1972,  
Dec; 42-3.

Scientific methods of evaluation must now replace the outdated system of examination in vogue in all educational institutions of the country. It has been explained in this article.

38 TYAGI (MD).

Growing facilities for Technical Education in Delhi.  
Fortnightly Journal of Industry and Commerce.  
1970, Aug 1; 17-8.

Delhi has a large population of unemployed youths. Thousands of them complete their education every year.

Many more come from other part of the country in search of jobs. Promotion of technical education is one way of solving the problem. The Delhi Administration is alive to the problem and the present executive council is keen to do its best in this regard. These points are being explained.

39 VARADAN (MS).

Technical Education.

Educational India. 37, N10; 1971, Apr; 355.

The basic points of this article are (1) organized interaction with industry (2) Feasibility of the sandwich training system (3) Autonomy for technical institutes to diversify courses (4) steps for development of entrepreneurial skills in the technically qualified, towards solving the employment problem.

377.001.8 Importance. Utility

40 BASHFORTH (GR).

Technical Training in India.

Eastern World. 25, N3/4; 1971, Mar/Apr; 9-10.

Need purpose and facilities are being discussed in this article

## 41 BHATTA (SK)

The need for a common technical vocabulary.

NIE Journal. 8, N2; 1973, Nov; 29-30.

Evolving a common technical vocabulary for the entire country are being discussed.

## 42 CHALLENGES OF Present day technical education.

University News. 18, N22; 1980, Nov 15; 631-2.

Job opportunity and job satisfaction are the focus of the study.

## 43 CHAVAN (SB).

Role of AICTE in the development of technical education: excerpts from the inaugural address delivered at the 25th meeting of the All India Council for Technical Education.

University News. 19, N10; 1981, May 15; 291-2.

The All India Council for Technical education has played a very significant role in the development of technical education in the country in 1947-48.

There were only 38 engineering colleges and 290 students but now 150 engineering institutions and 25,000 students. Role of the AICTE are being discussed in details.

44 GULATI (GL).

Technical Education and Standards.

Technical Teacher. 4, N1; 1970; 67-9.

The importance of equipping technical and engineering students with a good knowledge of the basic principles of standardization and their application has been highlighted. The following measures have been suggested for the purpose (1) Making the engineering, scientific and technical curricula standards-oriented (2) Associating the teachers of scientific and technical subjects with the standardization activities (3) impressing upon the students, the importance of the prevalent standards practices and drawing their attention to the relevant standards having a direct bearing on their subjects.

45 RAO (BR).

Role of Science and Technical Education in National Development.

University News. 18, N12; 1980, Jun 15; 321-5.

~~Inculcation~~ Explains need for a preparation of fundamental skills and inculcation of scientific temper which have acquired a new significance in the educational system of both the developed and developing societies.



- 46 RUDRA (KK) AND RASTOGI (SP).

Regional distribution of selected technical educational facilities in India.

Journal of Higher Education. 4, N1; 1978, Mon; 23-31

The growth in facilities in agriculture, engineering and medical education at the graduate level are being studied.

- 47 SARAN (Y).

India : A strategy to improve technical education.

Prospects. 6, N2; 1976; 245-53.

A high powered committee was appointed by the Government of India to suggest measures needed to reorganize polytechnic education. It was a realization that the whole process of improvement of technician education depend upon a continuous review and updating of the curriculum.

- 48 SINGH (PN) AND YADAVA (S).

Polytechnization of education.

Journal of Indian Education. 3, N4; 1977, Nov; 44-7.

Role and necessity of polytechnic education in human life are being discussed in this paper.

## 49 SRIVASTAVA (S).

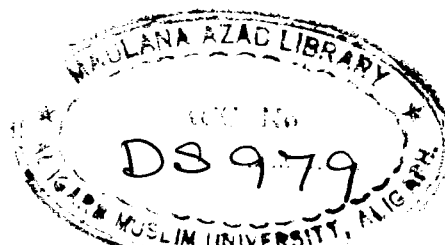
Interdisciplinary approach in professional education.  
NIE Journal. 6, N2; 1971; 1-5.

The need for an integral approach in professional education has been realised on learning that 1) a better educated man can do any job better than the less educated one; 2) no educational system can function in a vacuum; 3) the knowledge explosion has changed the past-oriented systems into future - oriented systems; 4) professional education is applied field. The following four-phased professional training programme has been suggested: 1) a good grounding in general education; 2) a deep study of the sciences - both Social and Natural as Physics, Chemistry, Biology, Neurology, etc., as the case may be; 3) a study as to how this knowledge of the Arts and Science is applicable to one's profession; 4) a good grounding in the history and development of his own professional field and in group dynamics and psychology of motivation which will prepare him to take the leadership role upon himself.

## 50 TECHNICAL EDUCATION.

Economic times. 1976, Apr 30; 9.

This article covers policies and objective of technical



education system; structures, linkage and centrals of the system growth and diversification, achievements and issues for future development are being discussed.

51 THEKKINIYATH (Francis).

Role of polytechnics and industrial training institutes in developing middle level technical manpower.

Industrial Engineering and Management. 11, N3; 1976, Jul/Sep; 28-33.

Attempts have been made in detail the different kinds of industrial jobs which technician engineers should normally be engaged in.

52 TIWARI (ND).

Science and Technical Education in India: excerpts from the Convocation address at the Indian Institute of Technology, Bombay.

University News. 20, N22; 1982, Nov 15; 699-701.

Need and importance of scientific and technical in India has been discussed in this paper.

53 VERMA (D).

Technical Vocational education: Need for a more pragmatic approach.

Journal of Indian Education. 6, N5; 1981, Jan; 23-6.

Technical vocational education has been a vital

concern of Indian educators for sometime, in ~~xxx~~ recent years it has become an even more crucial aspects of whole education pattern in India, and the continuing conflict over its aims has not lessened the confusion that has long prevailed. This article attempts to highlights a few of these problems and suggestions.

#### 377.003.2 Education Cost

54 ANAND (KK).

Analysis of in-company training costs + a case study.

Indian Management. 11, N2; 1972; 15-20.

The present study examines the nature of the training office costs, the cost-per-unit in terms of programmes, trainee days, training days, and how the costs of one year (1969-70) compare with those of the previous one (1968-69) in the case of Larsen & Toubro Ltd., Bombay. The limitations of the analysis are:

- 1) costs are not accumulated programme-wise;
- 2) avoidable expenses may be reflected in a prior year's cost; 3) all kinds of costs connected with training are not covered. The reduction of costs in 1969-70 due to increase in number of training days and programme participants indicates that

scope for cost reduction is considerable. It has been emphasized that cost of comparable intra-company vs. outside programmes should be explicitly considered in training decisions.

55 KHAN (QU).

Unit Costs of technical education : A study of their structure in Delhi.

Manpower Journal. 8, N1; 1972, Apr/Jun; 71-99.

The study of institutional unit costs can be useful in a number of ways.

- 1) For working out financial allocation and costing of educational programmes
- 2) For studying the level of efficiency at which the educational plant is run.
- 3) To compare inter-state and inter-institution variations

\*\* This paper attempts to throw some lights on these points and shows the trends in the unit costs of technical education imparted at craftman, technicians and degree levels.

377.007.6 Consultancy Service

56 SUBHASH (JR).

Technical Consultancy Service.

Yojana. 1971, Oct 3; 14-5.

Basic aim of this paper is technical consultancy services are potential source of foreign exchange earnings. Maximum utilisation of consultancy and engineering services available in the country and providing opportunities for their further developments are being explained.

#### 377.008 Organization, Management.

- 57 ALL INDIA Manufacturers Organization : AIMO background paper on seminar on reorientation of technical education to the requirement of industry.

Industrial India. 27, N9; 1976, Sep; 12-6.

Syllabus of postgraduate courses to improve the knowledge of working engineers are being modified. Research project is sponsored by industry and by Government agencies are also being encouraged. How far these efforts have permeated different educational institutions and with what success? The task before the conference is to review such progress for the national angle.

## 58 CHANDRAKANT (LS)

Management development in technical education.  
1st ISTE Karnataka Annual Commemorative Lecture,  
1982; 1-18.

Planning in retrospect and management of technical  
educations are being discussed.

## 59 GONES (CADC).

Organizational constraints to technical innovation  
in education.  
Journal of Indian Education. 9, N3; 1983, sep; 53-60.

Many attempts at technological innovation in technical  
education of different levels of development have  
faced serious obstacles and frustration. A common  
feature of many such attempts is that they try to  
rationalize educational systems on the basis of  
bureaucratic models. Schools are expected to work  
as enterprises and their technological core is to  
play the same role as that factories.

## 60 KHARE (Anand).

Organizing a large department in an educational  
institution.  
Indian Journal ~~DE~~ Technical Education. 4, N1; 1975,  
Aug/Dec; 20-4.

The main object is the head of the department cannot  
handle all the administrative tasks he must delegate

responsibilities to his members of staff. To set up different committees are being studied.

### 377.014 Policy

#### 61 NEW POLICY of Technical Education.

University News. 24, N17; 1986, May 1; 13-4.

A one-day seminar on New Policy of Technical education was recently organised at the University of Roorkee. The following recommendations emerged out of the deliberations of the seminar (a) Appex body for higher technical education, (b) Management of Technical Institutions, (c) Faculty development, (d) linkage with industry, (e) Curriculum development

### 377.014.542 Planning.

#### 62 HIRLEKAR (Y).

Technical & Vocational Education.

Progress of education. 48, N7; 1974, Feb; 238-44.

Training in vocations must be planned at different levels and the degree must be dissociated from service requirement. These suggestions are being explained.

#### 63 INDIA. EDUCATION & SOCIAL WELFARE (Ministry of -

Report of the special committee on reorganization and development of polytechnic education in India, 1970-1.

Report of special committees are explained. A list of polytechnic institutes those conducting certificate,



Diploma courses in various subjects are also given.

- 64 JAIN (PC) and PATKI (SD).

Planning a laboratory experiment.

Indian Journal of Technical Education. 6, 12; 1979,  
Aug/Dec; 89-91.

The main objective is technical education in laboratory experiences for the students serve as a powerful tool in making the teaching-learning process more effective.

- 65 KRISHNAN (AKU).

Reorganisation of polytechnic education.

Mainstream. 1970, Dec 5; 12-20, 25.

In planning for reorganisation of polytechnic education, two important aspects should be carefully considered. (a) Type and quality of manpower requirement and (b) its perspective growth of supply and demand.

- 66 NARAYANAN (MST).

Suggestions to reorient technical education

Hindu. 1971; Aug 30; 5.

In India, there is a very small percentage of those who are learning technological skills as engineers. The reasons behind this are being studied.

## 67 REORIENTATION OF Technical education.

Industrial India. 21, N2; 1970, Feb; 11-3.

Generally fresh graduates fail to come upto the expectations of interviewers due to some reasons. So the all Indian Manufacturers Organisation organized a seminar on reorientation of Technical Education at Poona to evaluate ways and means which would render the freshers out of the technical institutions functionally worthwhile. Several suggestions are being discussed in this article.

## 68 RE-ORIENTATION OF Technical Education.

Industrial India. 27, N8; 1976, Aug; 3-4.

The main purpose of the paper is to invite attention to the unsuitability of fresh engineering and technical graduate to the requirements of industry. It would be necessary to take such effective steps as are warranted to give practical bias to the curricula content of technical education in India. The curricula should be of such nature that it facilitates greater inter-action between education and industry.

## 69 SELVARAJAN (N).

Instructional resources Centre: A modern concept : roles and functions.

Indian Journal of Technical education. 4, N3; 1976,  
Dec; 119.20.

IRC should be planned to offer services directly related to the day-to-day problem of teachers and should stimulate worthwhile, creative educational changes in the process.

#### 377.112.4 Teachers, Instructors.

#### 70 AGGARWAL (SM).

An experiment in Technical Instruction : Programmed Materials for class-room.

Indian Journal of Technical education. 2, N2; 1972,  
Dec; 60-3.

This experiment was aimed at finding the (1) usefulness and (2) acceptability of programmes of technical education. Present programme exhibits potentialities of both.

#### 71 LAMBA (SS).

A rational approach for teaching load allocation and its measurement in units.

Indian Journal of Technical Education. 5, N2;  
Dec 1977/Apr 78; 50-1.

A new method of measuring teaching load has been proposed. Actual weightage to be used is somewhat arbitrary and can vary from one department to another. It is observed that if the unit system

is employed and if uniform teaching load units are allotted to each faculty member, it will contribute towards improved teaching.

72 NATARAJAN (V).

Instructional objectives in the teaching of surveying. Technical Teacher. 4, N1; 1970; 42-8.

Instructors teaching unskilled or semi-smilled bench assembly have been previously taught a 2-component system. The need to improve this method is considered. The instructor needs to be more aware of the process of learning in Trainees.

73 NATARAJAN (R).

The role of informal techniques in improving the **effectiveness** of formal education programmes.

Indian Journal of Technical education. 9, N1; 1986, Jan; 13-28.

Informal techniques have a significant supportive and complementary role to play in this regard. The use of modern educational technology offers the potential for meeting a number of challenges, are being studied.

- 74 TEACHING THROUGH Discussion Method in Technical Education Classes.

University News. 24, N3; 1986, Jan; 11-3.

Varieties of discussion techniques in higher technical education are being studied.

### 377.112.6 Teacher Training.

- 75 Adithan (M).

Subject Analysis.

Indian Journal of Technical Education. 7, N1; 1981, Apr; 27-31.

In the educational process, there are two main considerations, what to learn and how to learn?

In terms of teacher activity, this amounts to what to teach and how to teach. These points are being explained.

- 76 BANERJEE (B) AND SINHA (DK).

On some aspects of pedagogy in applied mathematics. International journal of mathematical education in science and Technology. 9, N3; 1978, Aug; 261-5.

This paper seeks to develop in broad outline some

pedagogical principles appropriate to teaching of applied mathematics. The meaning and possible connotations of the subject are discussed. Its origins and historical developments are described. The paper concludes with some possible pedagogical aspects of applied mathematics, stressing the importance of the right kind of attitude and of learning from experience.

77 BHATTACHARYA (SP).

Educational Technology in technical teacher education. Indian Journal of Technical Education. 3, N3; 1975, Apr; 108-14.

The paper is presented with the brief that educational technology properly supported and wisely employed could help meet some of the developing nations most pressing needs. The more lay-in of a core of capital equipment, indispensable as that is for further economic expansion does not yet catalyse a tradition<sup>a</sup> bound society into/modern one.

78 JHA (CS) AND MURTHY (SS).

The teaching of the theory of single-phase induction machines.

Indian Journal of Technical Education. 3, N1; 1974, Jul; 5-10.

This paper illustrated the use of the theory of

symmetrical components for teaching of single-phase machines. This method not only avoids conceptual pit-falls but leads to a precise establishment of the standard equivalent circuit.

79 NATARAJAN (K) AND SRINATH (H).

Student evaluation of teachers.

Indian journal of technical education. 3, N3; 1975, Apr; 105-7.

It is increasingly being recognized that students opinion on teaching is important and that due consideration should be given to these opinions. This article deals with the problems of allowing students to evaluate their teachers and suggests remedies. A sample questionnaire has been included.

80 PILLAI (SS).

Design of a training course for communication teachers in technical institutions.

Indian Journal of Technical education. 4, N3;1976; Dec; 115-8.

All major activities expected of an ideal teacher are included to make him dynamic, adaptive and efficient in the role assigned to him with special reference to the technical institutions in which he has to work.

- 81 RAO (MS) AND SESHADRI (CV).

Experience with a self-paced course.

Indian Journal of Technical Education. 3, N2; 1974,  
Dec; 38-42.

This article reports experience with course during its second year and provides some data and quantitative comparisons with conventional teaching procedures.

- 82 SARAN (Y).

Curriculum Development centre: T.T.T.I., Bhopal.

Indian Journal of Technical Education. 1, N2;  
1971, Dec; 62-4.

A report of the activities of the curriculum development centre at the Technical Teachers' Training Institute, are being explained.

- 83 SEN (B).

Training of teachers for Technicians education in India.

Education Quarterly. 2, N4; 1971, Jan; 20-8.

The main objective of this paper the existing academic staff is to remove their deficiencies by retraining programme, industrial orientation, pedagogical training. Inadequate technical knowledge are 1) lack of understanding of educational philosophy and objective of technicians courses 2) lack of proper communication due to lack of ability in teaching (3) lack of understanding of students needs.



- 84 SESHADRI (S) AND NILAVALAGAN (S).

Teaching of units and dimensions in mechanics.

Indian Journal of Technical Education. 5, N1; 1977,  
Apr/Aug; 20-4.

Aim is to present a method of teaching "Units and Dimensions". It has observed that students are able to understand the concept better and develop confidence in applying them to various situations. It is the authors' intention to share their experience with the teaching community the authors claim no originality in the method. Certain standardisations in notations and usage of special symbols have been attempted which were received by the students.

- 85 SRIRENGAN (K).

System approach to technician education.

Technical Teachers. 4, N1; 1970; 1-7.

The basic principles of system analysis and approach have been explained and applied to the functioning of an industry, enumerating the objectives of the top management and the methods by which they achieve the same. The principles of system approach have been further adopted to analyse the objectives of technical education, training practice and experience and for evaluating the curriculum for technicians.

- 86 VERMA (DVS).

Evaluation of a teacher.

Indian Journal of Technical Education. 4, N3; 1976,  
Dec; 121-4.

It is recommended that teacher be got evaluated by students. The proposed questionnaire may be used for this evaluation. Further it is recommended that after such evaluation the teacher be issued a certificate to this effect. Such certificates may be given due weightage at the time of confirmation and higher promotion.

#### 377.121.2 Admission Test.

- 87 ENTRANCE TEST for admission to polytechnics in A.P. University News. 22, N20; 1984, May 25; 15.

A common entrance examination is proposed by state governments. Qualification, Age etc. are being discussed in this article.

- 88 KHOBRAGADE (NT) AND PATIL(PR).

Review of admissions and performance of backward class students in a polytechnic.

Indian Journal of Technical Education. 7, N1; 1981, Apr; 7-11.

The study carried all projects. The strange inference that the facilities of the reservations applicable to various class of people, particularly S.C., S.T. and U.J. and N.T.

## 377.121.4 Prospectus, Curriculum, Syllabus.

- 89 BALARAMAN (Shakuntala).

Techniques of curriculum change.

Indian Journal of Technical Education. 4, N1; 1975,  
Aug/Dec; 15-9.

Discussion on some techniques by which the curriculum  
may be developed or revised.

- 90 DOSS (KSG).

The Q.B.S.(Question Based Syllabus) system.

Indian Journal of Technical Education. 3, N2;  
1974, Dec; 72-4.

Any educational system can be maintained at a  
high level of efficiency only by continuous review-  
ing of curricula and syllabi. Taking into account  
the changing circumstances for the improve, the  
training with a view to make the students better  
fitted to face the challenges.

- 91 GILL (J).

Curriculum design and student teachers of science.

British Journal of teacher education. 5, N1; 1979,  
Jan; 73-82.

This article is an account of course work structured  
to give students an understanding at the principles

of curriculum design through science field work.

92 NATARAJAN (KV).

Guided Modular System.

Indian Journal of Technical Education. 4, 113; 1976,  
Dec; 112-4.

The aim of this paper is to bring to light some of the deficiencies of the curriculum presently being followed at Technical Teachers Training Institutes in India. The philosophy of which is mainly to give a subject updating to diplomaes in Engineering and orientate all the teachers towards improved pedagogical methods and evaluation procedures. A presumably more effective training procedure termed as Guided Modular System derived mostly from systems approach personalised system of instruction and technician education. Council recommendations are being suggested.

93 PAI (MA) AND SESHADRI (MA).

A report on core curriculum seminars held by the curriculum development cell at IIT, Kanpur.  
Indian Journal of Technical Education. 4, 11; 1975,  
Aug/Dec; 12-4.

It has proposed that the objective of the cell

should be to organise study groups on the core programme in engineering college of India.

94 VERMA (D).

A new Approach to curriculum design in Technical education.

Journal of Indian education. 5, N4;, 1979, Nov; 28-34.

Basic aims of this paper are (1) To prepare the individual for employment in use of several entry jobs in a field of technology; (2) To provide the individual with broad based technical skills and knowledge, (3) To provide a background for continued study.

377.127 Examination.

95 KHOBRAGADE (NT) AND PATIL (PR).

Comparison of academic performance of polytechnic students with their own performance at the time of entrance in polytechnic.

Indian Journal of Technical Education. 8, N1; 1985, Jan; 22-30.

The paper presents the comparison of academic performance of polytechnic students at the final Diploma examination with their academic performance at the

S.S.C. examination. The influence of factors such as intellectual ability, habitation background, financial status and social status on the academic performance has been presented.

96 MURTHY (G Bhanu).

Assessment of internal assessment.

Indian Journal of Technical education. 5, N1; 1977, Apr/Aug; 17-9.

An attempt is made to assess the usefulness of internal assessment, a modern trend in the assessment of student.

97 NATARAJAN (R).

Some problems in evaluation of student performance.

Indian Journal of Technical Education. 4, N1; 1975, Aug/Dec; 25-7.

Both students and teachers have many faults to find in the examination system. The major differences between the essay and objective type questions are summarized. Some recommendations for making the essay type questions more objective are then enumerated. Every responsible teacher has an obligation not only to have competence in his field of study but also to keep abreast of the latest developments in educational technology in order to contribute to the overall effectiveness of the educational process.

## 98 NATARAJAN (V).

Continuous Assessment of Technician Student Performance.  
Education Quarterly. 23, N2; 1971, Jul; 41-4.

As a result of growing dissatisfaction with traditional time test examination, forward-looking educationists have recently been investigating. Some alternative method of assessing students performance are being discussed.

## 99 NATARAJAN (V).

Examination reforms in technical education.  
Education Quarterly. 25, N1; 1973, Apr; 27-32.

An attempt is made to study the American examination system and British examination system & suggestion is given for Indian examination system.

## 100 THAPAR (B) and GUPTA (BR).

Oral tests: A basis for awarding sessional marks.  
Indian Journal of Technical Education. 3, N2; 1974, Dec; 75-80.

The aims of this paper are to determine the boundaries and the depth of the student's knowledge in a certain field. To measure the student's ability in tackling engineering problems- to function as an incentive for studying and organizing the course material- To supplement and reinforce class-room teaching.

377.194 Problem in technical education.

101 CHANDRAKANT (LS).

Technical education: current problems and future prospects.

Manpower Journal. 9, N1; 1973, Apr/Jun; 15-41.

All problems and future prospects are being studied.

102 DUTTA (SK).

Problems of technical education: extracts from the 3rd convocation address of Punjab Engineering College, Chandigarh.

University News. 11, N4; 1973, Apr; 5-6.

Problems of technical education are being studied.

103 KHOSRAGADE (NT).

Problem of drop-out in polytechnics.

Indian Journal of Technical Education. 7, N1; 1981, Apr; 12-5.

Statistical Analysis of drop-out students who left the polytechnic course after selection are being studied. Explained the reasons behind this and also discussed the various problem of students.

104 NATARAJAN (KU).

Gaps in technical education and training.

Journal of Indian education. 6, N6; 1981, Mar; 9-11.

The practical training is to be fruitful, so there



should be good rapport between engineering colleges and industries. The people from industries should come forward to support engineering colleges and polytechnics are the purpose of this article.

377: 331.024      Technical Manpower.

105    KRISHNAMOORTHY (CS).

Education explosion and its effects on the composition of scientific and technical manpower.

Manpower Journal. 9, N4; 1974, Jan/Mar; 105-19.

Manpower structure at present is made up of persons who are their expertise and skill to on the job training and experience, they have gathered, in addition to their formal education.

377:374.2      Group Study & Discussion.

106    GULHATI (SK).

Towards Designing Useful tutorial work.

Indian Journal of Technical Education. 4, N1; 1975, Aug/Dec; 28-31.

Kind and process of Tutorial are discussed.

377: 338.45      Technical Education for  
Industrial Production.

107    VENKATA RAO (BS).

Education and Training for Industrial development in India.

Integrated Management. 55; 1970, Nov; 8-30.

The purpose of the present study is to categorize the skill competences needed by Industry into four main groups (a) operatives or semiskilled workers; (b) skilled workers or craftsmen; (c) supervisory personnel such as entrepreneur-managers, technicians, foremen, and management assistants and (d) engineers. Above mentioned points are explained.

108 VENKATA RAO (BS).

Education and training for industrial development in India : the problem of linkages ~~integrated management~~  
Integrated Management. 54; 1970, Oct; 8-13.

The principal objective of this study is to seek an answer to the question. How can the existing industrial education and training system in India be made more effective in realising the Government of India's aim and plans for industrialisation and bringing about rapid growth and modernisation of industry?

377 : 420 English Medium.

109 MALIAKAL (RG).

The study of english for Technical education.  
Indian Journal of Technical education. 5, N1; 1977,  
Apr/Aug; 14-6.

Survey are conducted through questionnaire for the analysis of the content of the English-

teaching programmes offered in engineering and technological institutions in India.

377: 65.001.8      Role of Industry.

110    RAO (MSV).

Role of industry in the management of technical education.  
Industrial India. 27, N10; 1976, Oct; 41-3.

India has registered phenomenal advancement in several fields of engineering and industry. Equally phenomenal has been the growth of technical institutions for producing technical persons for handling the country's and problem of development and growth. In this paper it is proposed to briefly examine these aspects and outline some suggestions, for gearing our educational institutions to provide all the talent needed in every field of industry and engineering.

377: 772.2      Blue Print.

111    BLUEPRINT FOR technical education.

Patriot. 1972, Apr 23; 8.

Some of the recommendations put forth by the All India Council for Technical Education at its 21st meeting are: 1) forming statutory boards or councils for technical education in States; 2) granting autonomy to select technical institutes; 3) constituting a joint committee of the All India Technical Council for Education and the University Grants Commission,

which will examine the structure of engineering education and suggest measures; 4) introducing sandwich courses in engineering education in order to meet the needs of industrial development; 5) offering scholarships to 25 percent students joining polytechnics so as to attract the best talent, and reserving a certain percentage of scholarships to skilled workers; 6) entrusting the Centre with the responsibility to share with States 50 percent of the expenditure the schemes may entail; 7) linking technical education with management techniques; 8) retraining teachers and starting a course for principals and heads of departments in polytechnics.

377.5 : 62 Technical Education in Engineering.

112 ABDUR RAHIM.

Engineering education in India.

Hindustan Times. 1972, Jun 11; 7.

The need for revision of engineering education within the framework of changing environment has been stressed. Indian students are less mechanically inclined and they accept the prescribed curriculum as best suited to their needs. Lacking the creative ability and possessing a weak theoretical background, the engineering graduates find the employment irrelevant to their

education. The faculty members are also primarily theoretically oriented and train pupils to be research scholars. Thus an average student, who is not desirous of pursuing a research career is left in an insecure position. The small scale industries made available to engineers have not progressed due to lack of patronage. The curriculum should therefore be made interesting to average students. The choice of engineering courses should enable pupils to reduce their subject load and train them to concentrate on a few. Project-type courses should be emphasised in theory and practicals from first year onwards. Building devices and systems should be stressed in laboratories. The postgraduate and research courses could be confined to Indian Institute of Technology. A research institute supported by the university should be attached to engineering departments to aid communication between the industry, research and engineering colleges. These institutes could feed the local industry and provide \* internship to students. Keeping in view the changing needs of society, efforts should be made to provide broad-based engineering education.

113 ADVANI (RN).

Some Notes on present day engineering education in India. Rajasthan University News. 9, N4; 1971, May; 3-5.

Presents some of the main points of the paper the recruitment of engineering degree courses. Datas are presented on the process by which male and female students got into engineering courses (i.e. promotions of students qualifying for degree courses and for engineering courses and actually entering engineering). The qualifications of engineering students compared with other students, and the commitment of engineering students to their courses compared with other students.

114

BAJPAI (AC).

Mathematical education of engineers part 1:

A critical Appraisal.

International Journal of Mathematical education in science & technology. 6, N3; 1975, Aug; 361-380.

This paper takes a critical look at the present state of mathematical education of engineers. It then suggests the improvement needed and proposes way in which they can be implemented. Attention is concentrated on identifying the problems and outlining a course developed by the authors in an attempt to meet the criteria for improvement.

115

BAJPAI (AC).

Mathematical education for engineers Part 2: Towards possible solutions.

International Journal of Mathematical Education  
in Science & Technology. 7, N3; 1976; 349-64.

This paper describes the course developed by the  
authors for teaching Mathematics to engineering  
undergraduates. The simultaneous techniques which  
are relevant to a particular topic is discussed.

116 BARUAH (SK).

Engineering education in total technology.  
Industrial time. 28, N12; 1977, Dec; 97-8.

Basic aims of this paper is to develop an outline  
of the type of postgraduate education necessary  
in the field of engineering technology. A model  
for Ph.D. courses for 3 years are also being dis-  
cussed.

117 BHARGAVA (Hari).

Engineers' problems.  
Times Weekly. 1972, Apr 9; 4.

A brief description of series of problems in his  
practical field are being studied.

118 BOSE (Sukumar).

Achievement motivation of engineering and non-  
engineering students in India.  
Journal of Social Psychology. 108, N2; 1979,  
Aug; 273-4.

The results of the study provide confirmation that the rationale content and structure of the Nach Naff Scale can survive translation into languages other than english, and that the scale may be useful in investigations of achievement motivation conducted in other countries.

119 DDOOPAR (BL) AND KAINTH (GS).

Scheme for practical training of the undergraduate engineering students.

Indian Journal of Technical Education . 2, N1; 1972, Aug; 14-5.

Numerous schemes for imparting practical training to the undergraduate students have been devised. It has been explained.

120. DE (AK).

Engineering education and its challenges.

Commerce. 1978, Ann; 205-9.

Update the knolwedge and experience in new trends and techniques are being discussed in this/paper

121 DHANANJAYA (MH).

Continuing education in the field of engineering and technology in developing countries. A case study of Indian context.

Indian Journal of Technical Education. 9, N1; 1986, Jan; 6-12.



Several disjointed, attempts have been made in the field of continuing technical education in recent past, some of them are being enumerated below.

(1) Holding the seminars/symposiums/workshops (2) Short-term training (3) Organised continuing education through institution (4) correspondence courses (5) adoption of modern technology like video and TV for continuing education etc.

122 EISEMAN (T).

Some predictors of institutional satisfaction : A study of engineering faculty.

Journal of Higher Education. 1, N3; 1976, Spr; 397-400.

This paper studies some predictors of job satisfaction among the engineering faculty in India. It considers how faculty rank and institutional affiliation contribute to job satisfaction and explores the implications of low job satisfaction for attitudes towards professional life in India.

123 GANDHI (AC).

Education of the engineers.

University News. 17, N22; 1979, Nov 15; 579.

The main objects of this article are, (1) To increase the engineering student's awareness of the economic, social and political situation in the country and

and to promote the development of technology appropriate to these conditions. (2) to equip students to cope with administrative and managerial demands of their environment. (3) to develop social sciences especially those to their sub-branches that interact with physical sciences and technical education etc.

124 GEHLAWAT (JK) AND KANT (Keshav).

Some aspects of teaching engineering design as a core-course at first year level.

Indian Journal of Technical Education. 5, N1; 1977, Apr/Aug; 3-6.

The main ~~objectives~~<sup>is</sup> of this course/to give the student, who is making a beginning of his engineering education a clear picture of what engineering and engineering design is required and offered.

125 GILL (D).

Towards more open performance appraisal.

Personnel Management. 9, N12; 1977, Dec; 31-3, 37 & 630.

The author reviews current practice in performance appraisal using a recent survey to show that appraisal continues to flourish, in spite of continual criticism. Research has drawn attention

to various defects e.g. central tendency in ratings, concentration on personality traits, complicated paperwork and untrained appraisers. In 1976 and 1977 the survey of appraisal schemes was carried out, by postal questionnaire, personal interviews and study of documentation.

126 GOPALAN (DK).

Continuing education of engineers in developing countries like India.

University News. 22, N23; 1984, Jun 16; 3-4, 12.

The basic objectives of this paper are (1) to develop specialized knowledge in specified fields of national relevance, (2) Training in research methodology and real life problem solving etc.

127 JAIN (ML).

Continuing engineering education.

Journal of Higher Education. 5, N1; 1979, Mar; 51-6.

The Government of India as well as the State Governments should also give all encouragement to all continuing engineering education programmes according to the need of the area. So needs are re-education from time to time through a flexible interacting programme of study and on the job experience suited

to his specific interest. These are the main purpose of the article.

128 HOW EFFECTIVE is our engineering education?

Indian Chemical Engineer. 13, N2; 1971; 1-2.

The two objectives of engineering education are: (1) the dissemination of knowledge with a view to developing the analytical abilities of students, and imparting information and know-how which may be useful currently as well as in the near future. Though the former objective is accepted as the academic objective of education and a source of innovation, the latter seems to be the real need of the present-day India. However, a curriculum based entirely on practical and job oriented objectives is currently considered inferior and suitable only for subordinate manpower. If it is agreed that these two objectives are to underline planning of programmes for engineering education, their effect on curricular and administrative structure should also be conceded. It has to be understood that admission to engineering colleges on the basis of school final examination results does not ensure the required level of academic competence. It is argued that students who have attained the required level of achievement should be admitted to

engineering colleges even if they have not completed the school career. The rigidly disciplined curriculum at the undergraduate level does not promote excellence. It is suggested that there should be plenty of freedom of choice to select courses even at the undergraduate level. With proper guidance Indian students are capable of making right choice.

129 JAYALAKSHMI (I).

A comparative study of the attitudes of social science and engineering students to certain aspects of higher education.

Journal of Higher Education. 5. N2; 1979, Aut; 233-6.

A survey was conducted on a sample 201 engineering students and 165 social science students from two ~~ma~~ major institutions in Delhi namely IIT & JNU.

The main points are compulsory attendance, self-study, home assignments, justification for admission value of course are the basic points of discussion.

130 JAIN (PL) AND JAGDISH LAL.

Cooperative Education in Engineering.

University News. 8, N8; 1970, Aug; 15-6.

The main prerequisites for the introduction of

cooperation course are as follows: (1) the cooperative education system is based upon the assumption that the programme is carried through in a pre-planned manner and there are no breaks, (2) necessary facilities for industrial training are to be created, (3) the syllabi of the studies at the college may have to be appropriately framed so that fullest advantage of the training periods can be derived.

131 KANITKAR (VJ).

Role of Engineer.

Industrial India. 35, N12; 1984, Dec; 45-7.

Various topics such as engineering work function, professional capabilities, technical area of challenge, technocratic professionalism and inevitable managerial requirements are discussed.

132 KRISHNAN (B).

The Anatomy of a Sick Engineering Unit.

Indian Management. 24, N4; 1985, Apr; 18-22.

A combination of continuous industry monitoring early warning of "black sheep" and consequent financial centrals and management assistance, is likely to be the only realistic remedy to this problem which are being studied.

133 KUPPUSWAMY (G).

Engineering Studies of development.

Educational India. 49, N2; 1982, Aug; 27-8.

Students entering engineering degree courses encounter special problems, which need to be dealt with during the first year, if maximum benefit is to be derived from both the course itself and vocation training in industry. Three major questions are; addressed by this paper (1) what can be done to improve the information about engineering degree courses and careers given to school teachers? (2) will the provision of appropriate induction training at the beginning of a degree course ease the problems of transition from school to university? (3) what can be done to ensure that engineering ~~students~~ students acquire the basic professional skills and develop the right attitudes to build a successful career in industry?

134 NATIONAL SEMINAR on Engineering education policy.

University News. 23, N41; 1985, Nov 1; 7-9.

A three-day seminar held at IIT Delhi and discussed following eight topics which are (a) faculty and Faculty development. (b) PG and UG Training Programmes facilities (c) impact of emerging technologies and

technology gap; (d) linkages with various system;  
 (f) resources and finances; (g) management structure  
 of engineering education and (h) quest for excellence.

- 135 (Engg.)  
 NEW ORIENTATION to technical/education urged.  
 Hindu. 1971, Feb 21; 9.

New orientation for engineering education is  
 being explained so that graduates would have the  
 skills incentives and facilities to set up small  
 manufacturing units of their own.

- 136 PATHAN (ND).  
 Engineers' Education.  
 Yojana. 1975, Sep 1; 3.

Suggests six months practical training course.  
 But who will give the training? the Government?  
 or Industrialists? These problems are being explained.

- 137 PILLAI (SS) AND BHATT (RN).  
 Informal Learning Alongside Formal Programmes in  
 Technical Education.  
 Indian Journal of Technical Education. 9, N1; 1986,  
 Jan; 29-34.

Non-formal education depends on students' initiative  
 and teachers' guidance. Informal methods/strategies  
 to help students keep pace with fast changing



technological world need to be integrated into the institutional programmes for reaping the maximum benefit. The problems of such integration need to be tackled resourcefully to make technical education socially relevant, industrially accountable and economically viable are being studied.

138 PUROHIT (DP).

Engineering: A professional career.

Industrial India. 36, N7; 1985; Jul; 19-21.

Describes following cardinal principles:

(1) highest standards in engineering are achieved by understanding the consequence of the practical application of technical concepts; (2) criterion of engineering is excellence in design; (3) management sustains effort enabling a concept to reach a foreseen and through planned development.

139 RAMACHANDRAN (A).

Engineering education.

University News. 11, N7; 1973, Jul; 4-6.

The topics discussed are as under:

(1) Cooperation between undergraduate and postgraduate programmes; (2) faculty can consult for industry at

senior as well as junior levels; (4) use of visiting committees for constructive interaction; (5) continuing education for engineering working in industry.

140. RAO CALLS for re-orientation of engineering education. Hindustan Times. 1970, Nov 17; 3.

Union Education Minister addressed the students of IIT at its Convocation and suggested the reorientation of engineering education so that a climate could be created among students to prefer self-employment and entrepreneurial activity to pay-pocket jobs.

- 141 RAO (VLN).

The stock of ITI Trained Craftsmen.

Manpower Journal. 17, N1; 1981, Apr/Jun; 25-34.

Statistical calculation of craftsmen having engineering degrees are being studied in this article.

- 142 SARMA (IG) AND SINHA (SK).

Indian Engineering education system: Some facets.

Indian journal of technical education. 9, N1;

1986, Jan; 1-5.

This survey is a first attempt by the engineering

community in India at identifying and evaluating the relative importance of vital issues on a quantitative basis. The target group for the survey includes (1) academics associated with engineering education. (b) engineering graduates employed in public and private sector industry, R & D establishments etc and (c) final year undergraduates, post-graduate and research students in engineering institutions.

143 SELVARAJAN (N).

Laboratory Centred Instruction: A new approach to engineering education.

Indian Journal of Technical Education. 4, N1; 1975, Aug/Dec; 33-5.

Laboratory courses have a crucial and specific role to play in technician education programmes are discussed.

144 SEMINAR ON Rotor spinning held at IIT Delhi.

University News. 19, N13; 1981, Jul 1; 359.

Role of rotor spinning in textile industry is explained.

145 SEN GUPTA (T).

How to reduce engineering-hours for MCCs by 50%.

Industrial India. 36, N12; 1985, Dec; 29-34.

The following points have been given for reducing the engineering hours. The paper discussed are as under:

- (1) designing the schemes (consultant); (2) choosing the component ratings; (3) mounting and wiring;
- (4) preparing external connection diagrams; (5) connecting up as per ext. connection diagram;
- (6) testing and commissioning; (7) trouble-shooting and (8) maintenance.

146 SRINATH (LS).

Large Deflections.

Indian Journal of Technical Education. 1, N1; 1971, Jul; 5-10.

Important functions of a laboratory in a technical institution is to bring to the attention of the student the differences between the behaviour of an actual physical model and its mathematical approximation as discussed in the class-room.

147 VINOD BIHARI AND GHOSH (P).

Biochemical Engineering : An Industrial View point.

Indian Journal of Technical Education. 3, N2; 1974, Dec; 67-9.

Author describes Biochemical engineering in close cooperation with microbiology, bio-chemistry, genetics

and mathematical sciences dealing with economic utilization of biological processes. A few institutions are conducting training and research programmes in this area.

377.5 : 62(021) Handbook.

148 ENGINEERING COLLEGES Admissions Handbook.

Dynamic business Management Centre, New Delhi.

Gives admission details of Bachelors Engineering degree courses of IITs and other engineering colleges.

149 HANDBOOK OF Engineering Education in India.

Oxford and IBH Publishing Co., Calcutta, 1985.

A list of engineering institutes of India are arranged state-wise. All details regarding admission entrance test, courses, seats, hostel facilities, fees etc. are given under each entry.

377.5 : 62(091) History.

150 WASTHI (D) AND THOMASON (J).

The advocate of engineering education in India.

Quarterly Review of Historical Studies. 11, N3; 1971/72; 154-62.

A brief description of engineering education in India during British period are being explained in this article.

377.5 : 62.001.5 Research

## 151 CHHATRAPATI (UM).

An engineering experiment station : A new approach.

University News. 22, N36; 1984, Sep 23; 7-8

The need for experiment in engineering education had been stressed. In fixing of experiment station, the following criteria have to be kept in view:

- (1) To conduct research on the natural resources of the area in which the institution is located;
- (2) To develop new industries for the area which do not now exist;
- (3) To aid those industries now in the area etc.

377.5:62.001.7 Improvement.

## 152 BALARAMAN (Shakuntala) and KRISHNAN (R.K.).

Toward institutional goal-consciousness.

Indian Journal of Technical Education. 8, N1; 1985, Jan; 4-11.

A faculty study regarding improvement are being explained in engineering education.

## 153 CHANDRA (D).

for  
Job Enrichment plan/maintenance engineers.

Industrial engineering and management 12, N1;  
1977, Jan/Mar; 13-7.

The purpose of the study is to formulate a job enrichment plan for the improved efficiency and satisfaction in engineers.

154

DULEEP SINGH.

Knowledge Engineering.

University News. 20, N6; 1982, Mar 15; 208-12.

Industrial engineers are required to adapt their techniques of improving work. Systems and management processes to meet the challenges of knowledge engineering.

155

GHOSE (AK)

Engineering education in India.

University News. 24, N19; 1986, May 16; 6-7.

For the improvement of engineering education in India some suggestions are being discussed in this paper (i) to establishment of an open university; (ii) investment of Rs. 400 to 500 crores by Government of India.

156

GROWTH OF Engineering education.

Capital. 1976, May 13; 721-22.

The basic principles of test and examinations test construction, administration and scoring of test are being discussed.

- 157 GUPTA (SK).

The Trouble-A- Brewing approach in engineering education.

Indian Journal of Technical Education. 5, N1; 1977, Apr/Aug; 7-8.

Two important characteristics of present-day engineering education first is the use of the problem solving approach and secondly is gradual shift of emphasis from technology to engineering science are discussed.

- 158 RAGHURAM SINGH (MR).

Qualitative improvement of technician engineering education.

Educational Review. 77, N2; 1971, Feb; 33-5 .

In the four-tiered structure of technical education in the country, Diploma courses in civil, electrical and mechanical engineering and in specialised technologies such as chemical, textile, leather, are being studied for preparing the technicians.

- 159 SAIN (Kanwar).

Responsibility of engineers of today and tomorrow.

Indian Journal of Power and River Valley Development. 25, N12; 1975, Dec; 383-5.



To collect and analyse facts, to make forecasts on any given problem etc. all responsibilities are being explained in the Annual Convocation of Roorkee University.

377.5 : 62.001.8      Importance.

160 BHATIA (BB).

Value engineering : A primer.

Indian Management. 20,N10; 1981, Oct; 29-31.

The purpose of the study is to determine the goal of engineering education to utilize the experience of young engineers. They are the test material for engineering education system.

161 KIRAN (DR).

Value engineering : a case study.

Industrial engineering journal. 6, N12; 1977, Dec; 30-33.

Value engineering is a management technique for the critical examination and analysis at the design of a component. This paper deals with the basic concepts and procedure for a value analysis programme. It gives a case study illustrating the value analysis programme conducted on one of the most critical components of a Traction Engine.

- 162     MANDAL (AK).

Engineer's education in a changing society.

Yojana. 1975, Jul 15; 24-5.

The purpose of the study is to determine the goal of engineering education to utilise the experience of young engineers. They are the test material for engineering education system.

377.5 : 62.003.2     Engineering Study  
Cost.

- 163     MANGLA (SM).

View with alarm: price of engineering education.

Publisher's Monthly. 12, N3; 1970, Mar; 15-7.

For abstract see 54.

- 164     RAGHUVAN (K) AND MANOCHA (Lalita).

Educational cost functions : A study of engineering educational institutions in India.

Manpower Journal. 11, N3; 1975, Oct/Dec; 50-87.

This paper is based on two studies conducted by the Institute of Applied Manpower Research relating to the pattern of expenditure and per student cost in IIT, Engineering College and Engineering Polytechnics.

377.5 : 62 : 338.93 Entrepreneur-  
ship for Engineers.

165 BASOLE (MM).

Teachers and entrepreneurship in young engineers.  
Productivity. 12, N1; 1971, Apr/Jun; 139-41.

Engineering education needs to be reoriented towards development of entrepreneurship. In this context, the engineering teachers can play a very significant role. It will, however, be necessary for the teachers to keep acquainted with recent technological developments. They must have fundamental grasp to find solutions to problems of practical nature. The immense untapped capacity available throughout the engineering colleges can greatly help not only better teaching but also in fostering entrepreneurship amongst engineering graduates.

166 CHATURVEDI (MC).

Engineering education and guidance for entrepreneurship.  
Productivity. 12, N1; 1971 Apr/Jun; 131-38.

A stage has been reached in engineering education and industrial activity when educational institutions cannot remain to be more ivory towers. There is imperative need for creating among our engineering students a new climate of preference for self-

employment and entrepreneurial activity. The engineering education must be given a new orientation, so that our new graduate will have the skill, the incentives, and the facilities to set up small manufacturing or consultancy or service units of their own. The task, no doubt, is challenging.

377.5:62 : 371.212 Admission

167 BALASUBRAMANIAN (A).

Admission to engineering college.

Hindu. 1981; Sep 10; 8.

Academic qualifications, method of selection, reservation of seats, Age etc. for admission in engineering college are being discussed in this article.

168 KARNATAKA LIKELY to reduce intake of engineering students.

University News. 19, N13; 1981, Jul 1; 360.

An attempt has been made to minimise the admission requirement for engineering students.

169 SHANTHAMANI (US).

Selection of students for engineering courses by means of entrance tests.

Indian Journal of Industrial Relations. 15, N1; 1979, Jul; 93-101.

Need for an entrance test and analysis of the results are being discussed in this article.

377.5 : 62: 371.214 Curriculum Syllabus.

170 BANTHIYA (NK) and MANI (RK).

Engineering education in 2000's: curricula change.

Indian Journal of Technical Education. 9, N1; 1986, Jan; 56-9.

A workshop was held at TTTI, Bhopal to collect ideas for the development curriculum. The following four themes formed the basis of this paper:

(1) Nature of knowledge, skills and attitudes to be developed in technical students in relation to anticipated technological changes; (2) Nature of programmes, including learning processes and delivery systems in the light of (1); (3) Nature of instructional resources that would be utilized to suit (1) and (2) ; (4) managerial issues to suit (1), (2) and (3).

171 GARG (RK).

The engineering curriculum: basic requisites.

Indian Journal of Technical Education. 4, N2; 1976, Apr/Aug; 60-2.

The primary object is to develop a basic understanding of engineering problems. Design a suitable syllabus for engineering education are being explained.

- 172 KRISHNAMOORTHY (S) AND MALHOTRA (RC).

Engineering education for the 2000's: Curricula changes.

Indian Journal of Technical Education. 9, N1; 1986, Jan; 46-55.

The curriculum which an engineering student studies is based on the anticipated needs immediately after his graduation as well as during his long career of thirty and thirty five years. Elements or parts of the curriculum will become obsolete. But a good part of curriculum must remain relevant and useful, and not become thoroughly anachronistic.

- 173 RAGHAVAN (MR).

Course in Engineering Design.

Indian Journal of Technical Education. 1, N1; 1971, Jul; 25-7.

Method of teaching engineering design stimulates the imagination and self confidence of the student. It emphasize that the large number of solutions will be able to conceive the greater probability of developing a creative design. It is suggested that similar courses be organized at graduate and undergraduate levels.

- 174 SRINATH (LS).

A methodology for subject identification and selection in engineering curriculum.

Indian Journal of Technical Education. 3, N2; 1974, Dec; 51-7.

The basic aim of this paper is to discuss subject identification and selection in curriculum development. A general methodology towards course or subject formulation is presented. The approach is rational rather than intuitive, i.e., it is based on a means-ends analysis rather than on speculation or inspired practices.

Examination.

- 175 BALU(SA) AND CHANDRAN(GS).

Inter examiner variability in assessing answer scripts of engineering sciences.

Journal of Higher Education. 5, N2; 1979, Aut; 224-8.

The purpose of the study are: (1) to investigate in to extent of variability between different examiners in assessing student answers in conventional examinations in engineering science subject; and (2) to study the influence of guidance provided to examiners in the form of model answers.

## Method of Instruction.

176 CHESTI (AR).

Effective engineering education.

Indian Journal of Technical Education. 7, N2; 1981,  
Aug/Dec; 1-4.

Teaching, considered to be an art at one time, is a science of communication, demonstration and evaluation to promote effective learning within and outside the classroom. These points are being explained. Stress is laid on the formulation of developmental plans reflecting fixation of priorities and urgencies to meet the genuine and immediate needs to motivate both staff and students to work and promote better teaching and learning standards are an ultimate aim of this paper.

177 NATARAJAN (V).

Effective methods of teaching and learning in engineering.

Indian Journal of Technical Education. 3, N2; 1974,  
Dec; 58-61.

An attempt is made in this paper first to briefly review existing teaching methods, their deficiencies and inadequacies, and then to highlight the change in the role of technical teachers in order to function effectively.



178 PARANJPE (PA).

Application-oriented teaching in engineering.

Indian Journal of Technical Education. 1, N2; 1971,  
Dec; 30-3.

The application-oriented teaching is demonstrated when the significance and utility of the first two laws of thermodynamics to a thermal power engineer are demonstrated by using the concept of energy.

179 SATSANGI (PS).

Feasibility Study of a mechanized dairy system.

Indian Journal of Technical Education. 1, N1;  
1971, Jul; 11-6.

A class-room example in teaching of system approach to engineering design projects are being explained.

180 SATYAM (M).

A unified approach to the teaching of electron devices course at undergraduate level.

Indian Journal of Technical Education. 5, N2;  
1977-8, Dec 1977/Apr 1978; 43-5.

Unified approach can absorb any new developments without sacrificing any material from the existing curriculum. This approach trains the student to think and tackle problems for themselves. These are being explained.

181 SESHANNA (P).

An approach to teaching : Rotating M.M.F. Waves.

Indian Journal Technical Education. 3, N1; 1974,  
Jul; 11-4.

A simple demonstration model and a lesson plan  
are described for teaching hor a rotating M.M.F.  
wave is produced by polyphase A.C. Machines.

377. 5 : 620.9 Energy Study.

182 CHANDRA (M).

An undergraduate course on energy studies.  
Indian Journal of Technical Education. 6, N2;  
1979; Aug/Dec; 97-101.

This paper deals with the possible topics that  
can be included in such a course, with brief  
description of the topics. This can be used as  
a rough guideline and the actual course could be  
formulated on the need of the students and the  
orientation of the Institution concerned.

183 RAO (RRM) AND THOMAS (A).

A development of curriculum for laboratory oriented  
course in solar energy.  
Indian Journal of Technical Education. 6, N2; 1979,  
Aug/Dec; 73-7.

The primary objective of this programme was to impart laboratory oriented course on applied solar energy to college and university teachers. The intention was to make the participants to be aware of various problems involved in the design and fabrication of solar devices and systems required for domestic and industrial applications.

377.5 : 621 Mechanical & Electrical  
Engineering Education.

184 ANANTHAKRISHNAN (MV).

NIFFT and its role in bridging the institution-  
industry gap.

Indian Journal of Technical Education. 4, N1; 1975,  
Aug/Dec; 36-8.

National Institute of Foundry and Forge Technology  
conducted various courses which are explained in  
this paper.

185 ASKHEDKAR (RD) AND KULKARNI (RV).

A system's approach to the teaching of Machine  
Tools.

Indian Journal of Technical Education. 4, N3; 1976,  
Dec; 103-4.

The approach proposed in this paper is to develop the subject in a logical way and keep the interest of the students alive in the subject.

186 BANERJEE (D).

Education and training in refrigeration.

Economic Times. 1972, Feb 10; 4-8.

The trained personnel required for refrigeration industry have been classified as mechanics, technicians, engineers and researchers. The following suggestions have been made regarding their education and training: 1) an organized programme of training for refrigeration mechanics should be taken up by the industries with the assistance of technical schools or institutes on the basis of a comprehensive curriculum drawn up for the purpose; 2) the training of technicians would fall in line more or less with a three-year full-time diploma programme or a four-year (sandwich) diploma programme; it should be strongly industry-oriented with maximum possible assistance from the industry; 3) the specialized training needed for engineers can be imparted either as a post-graduate diploma course in the universities or by the industries with active collaboration with educational institutions

for intensive fundamental training in courses like applied thermodynamics, heat, transfer, fluid mechanics, instrumentation, etc.; 4) bright engineering graduates may be selected by engineering institutes with suitable facilities to impart intensive postgraduate training in basic sciences, mathematics, instrumentation, and refrigeration and air-conditioning; 5) doctoral degree programme could also be provided with a real industrial problem in the project work; 6) specialized "Refrigerating Institutes", more or less on the same lines as that of Leningrad Technological Institute in the USSR may be started on a national basis and located in the areas where refrigeration industry has flourished or is likely to expand.

187 DUTTA ROY (SC) AND PRABHAKAR (A).

On the teaching of semiconductor electronics to undergraduate students.

Indian Journal of Technical Education. 1, N1; 1971, Jul; 17-9.

The purpose of this article is to discuss three approaches to the teaching of semi-conductor electronics to undergraduate students of electrical engineer, compare them, and justify the approach that has been adopted in IIT Delhi.

188 JAIN (VK).

Teaching Biomedical Electronics.

Indian Journal of Technical Technical. 3, N2; 1974,  
Dec; 70-1.

This paper suggests a syllabus for the teaching of bio-medical electronics to final year undergraduate students of electronics. The topics proposed are already being offered by the author as a one-semester elective course for final year B.Tech students in Electronics and Electrical Communication Engineering at IIT Kharagpur.

189 JESWANI (ML).

Need for introduction of a course on Unconventional machining methods at undergraduate level.

Indian Journal of Technical Education. 6, N2; 1979,  
Aug/Dec; 92-4.

An appropriate syllabus covering all aspects of new machining techniques is presented in this paper.

190 MURTHY (SS).

A simple educational model to demonstrate rotating magnetic fields.

Indian Journal of Technical Education. 3, N1; 1974,  
Jul; 2-4.

This paper presents a model which helps to demonstrate the concept of rotating magnetic fields in the airgap of a 3 phase machine.

The stator windings are excited by suitable magnitude of direct current at various instants of time by switching arrangement and the corresponding positions of the resultant MMF axis are detected.

191 MURTHY(SS) and LAMBA (SS).

On transition from a 5-year to a 4-year undergraduate degree programme in Electrical Engineering.

Indian Journal of Technical Education. 5, N2; 1977-8, Dec 1977/Apr 1978; 46-9.

The paper present some broad suggestions that may be followed in changing the present 5 year electrical engineering undergraduate programme to a 4-year programme. It is hoped that these recommendations would form a basis for further discussions in the academic community, and help in the transition to a new 4-year programme in those institutions which are currently following a 5-year programme.

192 MURUGESAN (M).

The course in television engineerint at IIT, Bombay.

Indian Journal of Technical Education. 3, N1; 1974, Jul; 29-33.

IIT, Bombay has been offering a course to postgraduate students. Degree is of two years duration. The first year is devoted to organize lectures, laboratory work, seminars etc. whereas the second year is spent on a project. The project requires the students to carry out as extensive literature survey and analysis of the problem, design and develop a prototype, carry out measurements, and discuss the results.

193 SABHU SINGH.

Writing Machine design assignments.

Indian Journal of Technical Education. 7,N1; 1981, Apr; 55-9.

In this paper some brief guidelines for writing a machine design assignments have been given. It is expected that these guidelines would be quite helpful to the students as well as teachers.

194 SARBHADHIKARY (SC).

Personnel training for thermal stations,Bhagirath. Irrigation and Power Quarterly. 17, N2; 1970; 86-8.

Maximum utilization of the available capacity coupled with the highest possible efficiency can only be achieved by proper operating practices,



adequate maintenance and skilled operating personnel who are properly trained; hence the need for specialised training. Based on the additional steam power generating capacity and envisaged in the fourth five year plan. It is estimated that the total number of operation and maintenance personnel required would be 7520 of whom 3240 would require training. There are at present two training Institutes one at Durgapur and the other at Neyveli. The Training imparted at Durgapur is described. A practice-oriented syllabus have been drawn and the course runs for 12 months comprising 335 hours of lectures for the mechanical group and 286 hours for electrical group besides in-plant demonstrations.

195 SENGUPTA (DP).

Teaching the generalised theory of electrical machines.

Indian Journal of Technical Education. 1, 23; 1972, Apr; 70-6.

How the theory of electrical machines should be taught to electrical engineering students in university particularly at graduate level, are being explained.

196 TRIPATHI (AN).

Laboratory Course Planning by objectives.

Indian Journal of Technical Education. 6, N2; 1979,  
Aug/Dec; 82-5.

The basic electrical engineering laboratory course is designed to provide the student with opportunity (a) to get familiarity with basic components, measuring instruments and equipments, (b) to observe basic phenomena and to seek explanations, (c) to get training in the measurement of basic electrical and non-electrical quantities.

197 YAJNIK (KS).

Dynamics of Turbomachines: A control volume approach.  
Indian Journal of Technical Education. 1, N1;  
1971, Jul; 1-4.

This article is aimed how methods of engineering science can be applied to the teaching of technological subjects. The classical subject of turbo machines is currently taught in various forms in aeronautical, civil and mechanical engineering courses. It may be assumed that the relevance of Turbomachines will ensure their continued importance in future curricula.

377.5 : 65 Management, Organisation of Industry.

198 AMIN (NB).

Cooperative (Sandwich) courses in engineering education.

Indian Journal of Technical Education. 3, N2; 1974, Dec; 62-6.

Five years back, in 1969 Baroda gave a pioneering lead to other universities and industries of India by initiating a cooperative course in engineering, education with active cooperation between the M.S. University of Baroda on one hand and engineering industry on the other. This experiment has made a tremendous contribution to the thought process regarding professional training and has helped the student community as well as the industries.

199 ARUNACHALAM (NU).

Management education for engineers.

Industrial Engineering & Management. 7, N3; 1972, Jul/Sep; 7-8.

An attempt is made to show how the engineers have lost their place in the society and must be done to regain the same. A stress is made upon

the necessity of the management education for engineers which in the opinion of the author would go a long way in establishing the position of the engineers in the society.

200 BHATNAGAR (RP).

New System of education : An integrated plan of education and employment.

Education Quarterly. 27, N1; 1975, Apr; 17-20.

Technical and vocational education to be largely through apprenticeship training for which selection to be made by Government agencies on the basis of competitive examinations and aptitude testing. The actual training programmes to be organized by the industries which have to employ the trainees ultimately.

201 CHOPRA (SK).

Sandwich system: Railways answer to our defective engineering education.

Indian Railways. 17. N10; 1973, Feb; 19-21.

Describes engineers should be educated in close contact with the industry so that they get a lively understanding of its working and learn all about the role they will have to play in it. This system is called sandwich system. Aims and objectives of this system are being discussed.

202 DAVE (R.).

The planning of instruction in engineering education.  
Indian Journal of Technical Education. 2, N2; 1972,  
Dec; 44-6.

The institute administrative and teaching personnel should be sufficiently sensitive to react changing demands of the profession and to the changing needs of the society. These points are being explained.

203 HEGDE (SP).

Institutional set up of management education,  
structural changes in management course.  
Economic Times. 1972, Jun 3; 5.

The root cause for the several ills of the management education is the lack of liaison between educational institutions and the local trade and industry. For instance, the lack of practical knowledge of the management degree holders is an outcome of the above-mentioned cause. Hence, close liaison between the business world and educational institutions, both at national level and at regional level, has been suggested. Attaching departments of management to selected universities is preferred to opening new autonomous management institutions. At the national level an All-India

board of management education, training and research may be set up. The members should be drawn from representatives from national bodies of trade, industry, banking insurance, etc. At the university level, it is suggested that the head of the department of management should be advised by a board of management in which should be represented the local trade, industry, etc.

204 KULKARNI (PD) and KRISHNAMURTHY (S).

Resource generation and effective management of resources for technical education.

Indian Journal of Technical Education. 9, N1; 1986, Jan; 35-45.

This paper attempts to cover the related problems with reference to the resources under three main heads namely (i) resource generation (financial resources); (ii) systems approach to management of technical education and (iii) optimisation of resources.

205 MITRA (CR).

Technical and Management Education vis-a-vis - industrial productivity.

University News. 20, N21; 1982, Nov 1; 662-4.

The theme of this paper makes the assumption that there exists a reciprocal relationship between technical and management education and industrial productivity. Studies of these concept are being explained.

206 MULLICK (SK).

On the need and scope of teaching fourier optics to the electrical engineering students.

Indian Journal of Technical Education. 4, N2; 1976, Apr/Aug; 70-3.

Communication theory and optics have suggested the need for a course on "optical signal processing" in any broad based electrical engineering academic programme at the final year undergraduate or postgraduate level. An outline of such a course has been suggested.

207 PRS. SANDWICH course in Engineering.

Industrial Economist. 1970, Jul 15; 13.

Sandwich course means practical training in industry. So need of this course for graduates are being studied.

208 RAO (NSV).

Role of industry in the management of technical education.

Industrial Engineering and Management. 11, N4; 1976, Oct/Dec; 21-3.

In this paper it is proposed to briefly examine these aspects and outline some suggestions, for gearing our educational institutions to provide all the talent needed in every field of industry and engineering.

209 REDDY (BG).

Class-room and industrial drawing practices.

Indian Journal of Technical Education. 4, N2; 1976, Apr/Aug; 66-7.

Principles of teaching engineering drawing which help to read industrial drawing more readily and useful are being discussed.

210 Saxena (SC).

Co-ordination of transportation engineering and planning education.

Indian Journal of Technical Education. 5, N1; 1977, Apr/Aug; 9-10.

The needs and responsibilities of the engineering educators in encouraging the planning courses in transportation engineering education and outlines a scheme of co-ordinating the engineering and planning education, the post-graduate level are studied.



## 211 SESHADRI (MD).

How the industry views the fresh graduate engineers.

Industrial Engineering & Management. 11, N4; 1976;

Oct/Dec; 2-4.

An attempt has been made to analyse the action-reaction processes, behaviour and treatment, impressions and feelings of a young engineer takes a job in an industry.

## 212 TRIPATHI (AN).

Master of Technical course and their relevance to Indian Industry.

Indian Journal of Technical Education. 6, N2; 1979,

Aug/Dec; 70-2.

Main object is to evaluate the right structure for the postgraduate education. It is **imperative** to associate professional engineers, particularly those during research and development in planning new courses and in revising existing courses.

## 213 TRIVEDI (RM).

Engineering education and industry.

Industrial India. 30, N9; 1979, Sep; 9-11.

The educational institution can play an important role in the growth and development of the small industries in the localities as well as in the country by bringing

in a methodology for implementation of modernization detailed and quick in plan studies, researches on indiveneous processes, other development and consultancy programmes.

214 VIRMANI (BR).

Graduate engineer trainees : A study.

ASCI journal of management. 12, N1-2; 1982, Sep; 108-11.

The industry feels that engineering institutions do not prepare the engineers required by industry, while the engineering college complain lack of cooperation from industry. A study was conducted by ASCI in collaboration with economic and scientific research foundation of FICCI, New Delhi. In this article identified weaknesses and suggested steps for improvement ~~is~~ are being explained.

377.5: 66 Technical Education in  
Chemical Industry.

215 GANGADHARAN (G).

Teaching Heat Transfer to Electrical Engineering Students.

Indian Journal of Technical Education. 2, N3; 1973, Apr; 90-4.

A subject can be taught well if the teacher has prior information of the background of the student on the basics of that subject or other subjects which have analogous phenomena or relations.

The idea is developed here and applied to teaching heat transfer by utilising its analogies in electrical engineering.

- 216 GOPALASUBRAMANIAN (S) and SRINIVASAN (NK)  
Fabrication and operation of a mini-cupola.  
Indian Journal of Technical Education. 6, N2; 1979;  
Aug/Dec; 95-6.

The mini-cupola designed and fabricated can be used for routine demonstration and for trial purposes to manufacture special grades of cast iron are being discussed for technicians.

- 217 ROY (GK).  
Chemical Engineering Education in a developing nation(Indian Scene).  
Chemical Age of India. 29, N7; 1978, Jul; 607-14.

Engineering activities in which chemical engineers are engaged in their professional life, are being discussed.

- 218 SRINIVASAN (NK) and RAMAKRISHNAN (SS).  
Improvement and Innovations in teaching metallurgical engineering at undergraduate level.  
Indian Journal of Technical Education. 8, N1; 1985,  
Jan; 1-3)

It has been emphasized that apart from traditional approach in teaching metallurgical engineering, the engineering approach with problem solving methods needs to be strengthened in the undergraduate curriculum.

377.5 : 678    Technical Education in  
Polymer Science.

219    ANIL KUMRAR and GUPTA (SK).

A new experiment in polymer science education.

Indian Journal of Technical Education. 4, N2; 1976,  
Apr/Aug; 57-9.

The experiment helped in establishing some very basic facilities of a polymer laboratory, are being explained.

377.5:681.3    Technical Education in  
Computer Science.

220    AROLE (PD).

Training in Computer Programming.

Indian Educational Review. 7, N1; 1972,; 209-18.

Highlights the important features of the course in programming at the Government of India Computer Centre, New Delhi, such as the syllabus, methods of teaching, the place of quizzes and tests in training and practical computer operations. The utility of a constant dialogue in effecting improvements in educational standards is also

brought out.

- 221 CHANDRASEKHARAM (R) and SINGH (MP).

A Microprogrammable Processor: An experimental kit for computer technology laboratory course. Indian Journal of Technical Education. 6, N2; 1979, Aug/Dec; 78-81.

Experimental needs to be designed at an intermediate level which is above the study of gates up flips flops and blow the use of advanced microprocessor chips. So the students would have handled the M.S.I. circuits before going to use the bigger L.S.I. circuits.

- 222 MEHTA (MM).

Rapid development in computer careers. Indian Express. 1978, Oct 13; 4.

The object is to develop the computer-oriented algorithm to design/analyse engineering system.

- 223 NATARAJAN (R).

Programmed instruction and teaching machines. Indian Journal of Technical Education. 2, N1; 1972, Aug; 2-6.

Developments and research in such apparently diverse fields as experimental x psychology

computer technology and electronics have resulted in the evaluation of educational technology, whose primary goal is to produce enhanced learning effectiveness. Any teacher who can be replaced by a machine deserves to be replaced. These points are being explained

224 PRASAD (KP).

A course in programming techniques and numerical methods.

Indian Journal of Technical Education. 3, N3; 1975, Apr; 115-6.

An engineer should know how to use a digital computer for his tedious computational problems. Study of analog computers is also included to make it a comprehensive course on computer methods.

225 SASTRI (RC).

Computer assisted instruction.

Indian Journal of Technical Education. 3, N2; 1974, Dec; 43-50.

In developing countries in India where basic education is to be imparted to millions of people to wipe out illiteracy, CAI holds a very bright future, if properly used to remove illiterary.

226 SHANKAR (ND).

Computer science and technology : facility requirements and certification of academic programmes  
Journal of Higher Education. 7, N3; 1982, Spr;  
324-6.

This paper have the objects:

(a) scientific computation and analysis of data generated by the university teaching and research departments; (b) education administration involving data analysis for admissions examinations, results; (c) training of students and developing computer capabilities; (d) research in software/hardware developments.

227 SRIDHAR (C) and DESAI (HR).

Need-oriented computer education.

Journal of Education and Psychology. 40, N1-2;  
1982, Apr/Jun; 8-17.

In this paper the existing set up in the academic institutions and the needs of the industry are surveyed problems in the area of computer manpower development have pinpointed here. Solutions for consideration by academic institutions, the computer industry and CSI are also suggested.

377.5 : 781.6. Technical Education in  
Instrumentation.

- 228 BHANDARI (NC) and SRINIVASAN (V).

Gyroscope apparatus.

Indian Journal of Technical Education. 3, N1; 1974,  
Jul; 21-3.

An easily fabricated working model for a  
gyroscope useful for laboratory experiments is  
described.

- 229 JAIN (UK).

Proposal for a one-year postgraduate diploma course  
in biomedical instrumentation.

Indian Journal of Technical Education. 5, N2; 1977-8,  
Dec 1977/Apr 78; 52-4.

This paper suggested a syllabus for a one-year  
diploma course in biomedical instrumentation.

230. SHARMA (BL).

The teaching of Instrumentation.

Indian Journal of Technical Education. 3, N3; 1975,  
Apr; 82-5.

Discussed the need of training for instrumentation  
engineers. The study of an academic discipline  
can be divided into two parts. The first part  
is designed to cover areas which are considered



'basic' the second deals with a number of specialization.

### 378.6 Higher Technical & Vocation Education.

231 CHATURVEDI (VIPULA) AND CHATURVEDI (MZ).

Higher Technical Education : Pattern, Trends and Implication for developing countries.

Journal of Higher Education. 2, N3; 1977, Spr; 377-86.

Technical education is concerned with the intellegent utilisation of materials and forces for the benefit of mankind starting as a craft engineering as evolved over a wide range of activity and capability, the historical movement of technical education has grown from professional emphericism through engineering science to the modern concen on social interaction.

232 DIXIT (DK).

IITs : Island of excellence.

Industrial Times. Dec 24, 1984/June 6, 1985; 39-43.

A bird's eyeview of the IIT, Bombay campus and vibrant, vital and variegated mirrors of the current ethos are being explained.

233 TOYAL (SC).

Objectives and formation of technical university  
Indian Journal of Technical Education. 8, N2;  
1985, Jul; 1-6.

New avenues of promotions and work satisfaction  
for teachers are being discussed in a new  
established engineering college

234 IIT's NEW offer to SC/ST students.

University News. 21, N3; 1983, Feb; 86.

To provide financial assistance to SC/ST candi-  
dates, are being explained.

235 INDIAN INSTITUTE of Technology, Delhi : Silver  
Jubilee 1985-6.

University News. 23, N47; 1985, Dec 16; 3-7.

Academic policies, assessment modalities etc.  
are being explained.

236 KHANIJO (MK) and RAMAN (Radha).

**Improving** utilisation of engineering manpower  
through education planning.

Lok Udyog. 12, N9; 1978, Dec; 3-7.

University must ensure that their courses are  
relevant to the need of society. Thus there is  
a continuing debate concerning the best form  
of education for future professional engineers.  
This paper relates to the training of post-  
graduate engineers and it is demonstrated that  
collaborative ventures between industry and the

universities are an excellent development for all the parties concerned. A number of case studies, relating to the author's direct experience, are described.

237 KHOBRAGADE (NT) and PATHAK (DV).

Generalised approach for effective training in an industrial house.

Indian Journal of Technical Education. 8, N1; 1985, Jan; 17-21.

In this paper attempts have been made to delineate the effective procedure which would give the logical co-relationship existing between several activities in the industrial house so as to derive the maximum use of available resources.

238 KUMAR (RP).

Role of Technical Institutions in the solution of problems of small scale industries.

Chemical Age of India. 27, N6; 1976; Jun; 549-51.

In this article the author pleads the case of small scale industry for greater technical assistance from the educational institutions. During the last three or four years, industrial consultancy centres have been set up in all the IITs arrangements have been introduced for exchange of staff between the institutions and industry.

239 MUTHUKUMARAN (S).

Medium of instruction in technical institutions.

University News. 14, N6; 1976, Jun; 4-8.

In most of the countries of the world, the language used for instruction is the native language. Choice of the language of instruction arguments for english, psychological aspects, implementation aspects of English Medium etc., are being discussed.

240 NATARAJAN (R).

On promoting interaction between the University and Industry.

Indian Journal of Technical Education. 8, N1; 1980, Jan; 12-6.

A mutual relaxation of both industry and technical university policies leading to better communication mutual trust interest effective commitment, lasting relations and person to person. Contact is beneficial not only to the industry and university but also to the national development as a whole are being studied.

241 PATIL (SD).

Shortage of good teachers in engineering college. Hindu. 1982, Jun 8; 19.

The object of this paper is to develop the competencies of teachers teaching productivity and

quality control of new development in the field.

242 PROPOSAL FOR Technical University.

Hindu. 1975, Mar 28; 6.

Due to high demand of technical education suggestio and need to establish technical university just like IITs, arebeing studied.

243 RAO (RR).

Delhi IIT's achievements.

Yojana. 24, N24; 1981, Jan; 30-1.

The highlight of the institute's achievements this year is to establish a two-way troposcatter communication link between the IIT and the central electronic research institute, Pilani. It is the first of its kind in India and will benefit the number of departments like Defence, Civil Aviation, A.I.R., P & T and so on and the IIT itself to develop methods for better utilisation of existing resources of energy and alternative sources and techniques to harness, new source of energy etc., are the basic points of this paper.

244 SHRI PANT address Convocation of IIT, Bombay.

University News. 23, N44; 1985, Nov; 41-3.

Basic aim is the success of technical education depend upon the effectiveness of its linkages with several systems such as industry, government and the various professional bodies and to establish

effective linkages, it is essential that we identify areas of interest to develop mechanisms for their interaction.

245 SINGH (NK).

Shadow over Delhi IIT.

Frontier. 1973, Jan 27; 9-10.

A general description regarding its departments, courses, results performance and future prospects of students are being explained.

246 SINGH (RH).

Academic management of Technical Institution.

University News. 19, N7; 1981, Apr; 189-9.

(i) To reduce the stereotyped functions and situations

(ii) To eliminate the elite values vis-a-vis the fast evolving set up (iii) to break down bureaucratic aspects of all educational activities and (iv) to bring about a rapid decentralization of administration, are being discussed in this article.

247 SREENIVASAN (S).

Foreign-aided IIT education.

Journal of Higher Education. 4, N2; 1978, Aut; 187-200.

This paper explain from 1961 to examine the role of foreign assistance from different countries and UNESCO.

## 248 TECHNICAL UNIVERSITY for Punjab.

University News. 18, N23; 1980, Dec 1; 657.

Provision for to open a technical university in Punjab are being discussed.

## 249 UNDERGRADUATE ACADEMIC Assessment at IIT Delhi.

University News. 18, N23; 1980, Dec 1; 650-2, 654.

A need has been felt to clearly define the objectives of examination procedures and to develop reliable methods of evaluating students' academic performance.

## 250 WAKHLU (OB).

Problems of engineering college in India with regard to teaching and research.

Indian Journal of Technical Education. 7, N1; 1981, Apr; 32-5.

The cost of education is almost the same at all the engineering institutes, the parents wants that the training should be uniformly of the same standard at all the colleges. The common problems in this regard are being explained.

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